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Scientific and Technical Aerospace Reports

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of the National Aeronautics and Space Administration

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Includes administration and management; space law and related legal matters; legislative hearings and documents; and symposia or conferences of a broad or general nature.

N64-15006 Joint Publications Research Service, Washington, D.C.
STUDIES IN POWDER METALLURGY
Ivan Mikhaylovich Fedorchenko and Rotislav Aleksandrovich Andriyevskiy 28 Jan. 1964 92 p refs Transl. into ENGLISH from the book "Osnovy Poroshkovoy Metallurgii" Kiev. Izd. AN Ukr. SSR, 1961
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N64-15102 Office of Naval Research, London (Gt. Brit.)
NATO ACTIVITIES IN RESEARCH AND DEVELOPMENT
I. Estermann In ONR Solution to Navy Probl. through Advanced Technol. [1963] p xvi–xxx (See N64-15101 07-01) OTS: $5.00

The major groups of NATO that deal with research and development are: (1) the science committee and the division of scientific affairs; (2) the armaments committee and the production, logistics, and infrastructure division; (3) the advisory group for aeronautical research and development—the aerospace medical panel, avionics panel, combustion and propulsion panel, flight mechanics panel, the fluid dynamics panel, structures and materials panel, technical information and documentation committee, international consultant and exchange program; (4) training center for experimental aerodynamics; (5) the SHAPE (Supreme Headquarters, Allied Powers, Europe) air defense technical center, (6) the scientific advisor to SACEUR (Supreme Allied Commander, Europe), and (7) the SACLANT (Supreme Allied Commander, Atlantic) ASW (Anti-Submarine Warfare) research center. R.T.K.

N64-15103 Southwest Center for Advanced Studies, Dallas, Tex.
INNOVATION: THE NEW RESOURCE
Lloyd V. Berkner In ONR Solution to Navy Probl. through Advanced Technol. [1963] p xxxi–xxxvii (See N64-15101 07-01) OTS: $5.00

A review and evaluation of the program of research and development that supports the naval forces of the U.S.A. are presented. R.T.K.

N64-15166 Joint Publications Research Service, Washington, D.C.
CYBERNETICS IN PEDAGOGY AND COMMUNICATIONS
11 Feb. 1964 22 p refs Transl. into ENGLISH of 3 Russian articles
(JPRS-23187; OTS-64-21540) OTS: $0.75

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N64-15168 Joint Publications Research Service, Washington, D.C.
COORDINATION OF SCIENTIFIC-RESEARCH WORK IN THE FIELD OF PEDAGOGICAL SCIENCES
A. I. Markushevich *In its* Cybernetics in Pedagogy and Commun. 11 Feb. 1964 p 10–16 Transl. into ENGLISH from Sov. Pedagogika (Moscow), v. 26, no. 8, 1962 p 54–58 (See N64-15166 07-01) OTS: $0.75

The problems of coordinating pedagogical research in the Soviet Union are discussed. A major role in developing the work of coordination is carried out by the Councils for Coordination and Planning, which exist in the ten economic regions of the RSFSR. P.V.E.

N64-15182* California U., Los Angeles Inst. of Geophysics and Planetary Physics
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Gordon J. F. Mac Donald 1963 361 p refs
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3. HYDROMAGNETIC WAVES IN SPACE G. J. F. Mac-Donald 50 p refs (See N64-15185 07-28)

N64-15201* California U., Berkeley Lawrence Radiation Lab.
SEMIANNUAL REPORT – BIOLOGY AND MEDICINE, SPRING 1963
John H. Lawrence and Tove Neville, eds. 1963 158 p refs
(NASA Order R-41; contract W-7405-eng-48)
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15. USE OF A WHOLE-BODY COUNTER IN TURNOVER STUDIES WITH Ca^{47} T. Sargent, J. A. Linfoot, H. Stauffer, and J. H. Lawrence p 130–138 refs (See N64-15216 07-16)

16. HEAVY-PARTICLE IONIZATION (H, He, Li, B, C, N, O, F, Ne, Ar) AND THE PROLIFERATIVE CAPACITY OF NEOPLASTIC CELLS *IN VIVO* K. Sillesen, J. H. Lawrence, and J. T. Lyman p 139–151 refs (See N64-15217 07-16)

N64-15226* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

ADVANCED BEARING TECHNOLOGY

Edmond E. Bisson and William J. Anderson Washington, NASA, 1964 517 p refs

(NASA-SP-38) GPO: $1.75

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1. INTRODUCTION AND DEFINITION OF NEWER PROBLEM AREAS E. E. Bisson (NASA) p 1–13 refs (See N64-15227 07-17)

2. BOUNDARY LUBRICATION E. E. Bisson (NASA) p 15–61 refs (See N64-15228 07-17)

3. HYDRODYNAMIC LUBRICATION W. J. Anderson (NASA) p 63–96 refs (See N64-15229 07-11)

4. HYDROSTATIC LUBRICATION W. J. Anderson (NASA) p 97–108 refs (See N64-15230 07-11)

5. GAS-LUBRICATED BEARINGS J. S. Ausman (Litton Ind., Inc.) p 109–138 refs (See N64-15231 07-11)

6. ROLLING-ELEMENT BEARINGS W. J. Anderson (NASA) p 139–173 refs (See N64-15232 07-17)

7. LIQUID LUBRICANTS D. H. Moreton (Synthetic Fluids Service, Inc.) p 175–201 refs (See N64-15233 07-19)

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10. FRICTION OF METALS, LUBRICATING COATINGS, AND CARBONS IN LIQUID NITROGEN AND HYDROGEN E. E. Bisson (NASA) p 289–307 refs (See N64-15236 07-17)

11. EXTREME-TEMPERATURE BEARINGS W. J. Anderson (NASA) p 309–370 refs (See N64-15237 07-17)

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14. LUBRICATION OF BEARINGS WITH LIQUID METALS W. J. Anderson (NASA) p 469–496 refs (See N64-15240 07-18)

N64-15251 Air Force Systems Command, Edwards AFB, Calif. Space Systems Div.

TRANSACTIONS OF THE EIGHTH SYMPOSIUM ON BALLISTIC MISSILE AND SPACE TECHNOLOGY, VOLUME 2

[1963] 421 p refs Symp. conducted by Aerospace Corp.; held at the U.S. Naval Training Center, San Diego, Calif., 16–18 Oct. 1963

(AD-427701)

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2. EFFECTS OF NONEQUILIBRIUM ON THE HYPERSONIC LAMINAR BOUNDARY LAYER P. De Rienzo, F. Berner, A. D. Woods, and J. D. Teare (Avco-Everett Res. Lab.) p 35–64 refs (See N64-15253 07-11)

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4. ANALYSIS OF ELECTROMAGNETIC WAVE PROPAGATION THROUGH RE-ENTRY INDUCED PLASMA SHEATHS R. R. Gold (Aerospace Corp.) p 83–96 refs (See N64-15255 07-24)

5. INTERACTION OF HIGH-POWER MICROWAVES WITH A RE-ENTRY VEHICLE PLASMA SHEATH M. Epstein (Aerospace Corp.) p 97–119 refs (See N64-15256 07-24)

6. A SIMULATION OF MULTIPLE RE-ENTRY VEHICLE DELIVERY H. C. Sebring and S. Matlin (GE Co.) p 123–157 refs (See N64-15257 07-30)

7. THE PRESENT AND FUTURE ROLES OF STRAPPED-DOWN INERTIAL SYSTEMS J. C. Powell (Minneapolis-Honeywell Regulator Co.) p 161–178 ref (See N64-15258 07-22)

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9. ORBIT DETERMINATION ERROR ANALYSIS D. R. Speece (Aerospace Corp.) p 197–228 (N64-15260 07-29)

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13. RESONANT-SCATTER DETECTION OF MIDCOURSE VEHICLES: MINIMUM DETECTABLE NUMBERS OF RESONANT-SCATTERING PARTICLES L. Glatt (Space Technol. Labs., Inc.) p 309–334 refs (See N64-15264 07-21)

14. A 2.5 WATT X-BAND TRAVELING-WAVE TUBE AMPLIFIER FOR SATELLITE APPLICATIONS R. E. Pospisil (Watkins-Johnson Co.) p 335–368 refs (See N64-15265 07-09)

15. MANNED ANTI-SATELLITE SYSTEM E. E. Honeywell (General Dynamics Corp.) p 369–409 refs (See N64-15266 07-32)

16. ELECTROMAGNETIC RADIATION HAZARDS TO ELECTROEXPLOSIVE DEVICES R. B. Moody (AF Dept.) p 411–420 refs (See N64-15267 07-26)

N64-15276 Georgetown U., Washington, D.C. Georgetown College Observatory

RECENT ADVANCES IN ASTRO-GEOPHYSICS

Francis J. Heyden [1961] 139 p refs Symp. based on Lectures delivered at the Summer Conf. for Coll. Prof. on Phys. and Astron., Washington, D.C.

(NSF Grant-16787)

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1. THE TOOLS OF THE MODERN ASTRONOMER F. J. Heyden (Georgetown U.) p 1–7 (See N64-15277 07-05)

2. ASTROPHYSICAL RESEARCH WITH HIGH DISPERSION INSTRUMENTS C. C. Kiess (Georgetown U.) p 8–12 (See N64-15278 07-05)

3. UPPER ATMOSPHERE PHYSICS E. O. Hulburt (Naval Obs.) p 13–20 (See N64-15279 07-12)

4. GEODETIC APPLICATIONS OF SATELLITE TRACKING J. A. O'Keefe (NASA) p 21–28 (See N64-15280 07-12)

5. SATELLITE WAKES W. J. Thaler (Georgetown U.) p 29–38 (See N64-15281 07-32)

6. BACKSCATTER TECHNIQUES IN GEOPHYSICS W. J. Thaler (Georgetown U.) p 39–47 (See N64-15282 07-12)

7. THE VAN ALLEN RADIATION BELTS C. A. Pearse (Naval Res. Labs.) p 48–59 refs (See N64-15283 07-28)

8. TEKTITES AND THE MOON J. A. O'Keefe (NASA) p 60–65 (See N64-15284 07-05)

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11. PHYSICS OF THE SUN C. E. Moore (Natl. Bureau of Standards) p 73–78 refs (See N64-15287 07-05)

12. INFRARED TECHNIQUES IN ASTROPHYSICS G. J. Zissis (Michigan U.) p 79–93 refs (See N64-15288 07-05)

13. RADIOASTRONOMICAL OBSERVATIONS OF THE MOON AND PLANETS J. P. Hagen (NASA) p 94–104 (See N64-15289 07-05)

14. DISTRIBUTION OF STARS F. J. Heyden (Georgetown U.) p 105–110 (See N64-15290 07-05)

15. THE ORIGIN AND ABUNDANCE OF THE ELEMENTS W. R. Brode (Georgetown U.) p 111–116 refs (See N64-15291 07-12)

16. COSMIC RADIATION D. P. Stern (Md. U.) p 117–130 refs (See N64-15292 07-28)

N64-15312 Air Force Missile Test Center, Patrick AFB, Fla.

NEW DATA REDUCTION METHODS TO IMPROVE RANGE DATA

404 p refs Papers presented at the 4th Joint AFMTC–Range User Data Conf., Orlando AFB, Fla., 26–28 Feb. 1963

(AD-429095)

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1. ERROR PROPAGATION J. N. Jamieson (RCA) p 7–16 (See N64-15313 07-20)

2. BALLISTIC CAMERA ACCURACY REVIEW G. H. Rosenfield (RCA) p 17–54 (See N64-15314 07-15)

3. MISTRAM K. E. Relf (RCA) p 55–109 (See N64-15315 07-08)

4. THE GLOTRAC SYSTEM J. W. Stephenson, Jr. and R. K. Weller (RCA) p 111–120 (See N64-15316 07-09)

5. ADVANCED RANGE INSTRUMENTATION SHIPS N. L. Hanson and A. B. Ward (RAC) P 121–143 (See N64-15317 07-10)

6. THE ERRORS OF INERTIAL GUIDANCE SYSTEMS M. J. Jaenke (AF Missile Develop. Center) p 145–181 (See N64-15318 07-22)

7. DATA SMOOTHING J. R. Garrett and D. B. Gennery (RCA) p 183–196 (See N64-15319 07-20)

8. APPLICATIONS OF DATA FILTERING TECHNIQUES TO DATA PROCESSING M. A. Martin (GE) p 197–223 ref (See N64-15320 07-09)

9. RADAR ANALYSIS PROGRESS A. E. Hoffman-Heyden (RCA) p 225–259 (See N64-15321 07-08)

10. THE CYCLIC ERROR AS AN ATMOSPHERIC REFRACTION PHENOMENA W. Dryden and O. J. W. Christ (RCA) p 261–284 refs (See N64-15322 07-20)

11. INSTRUMENTATION ERRORS DUE TO ATMOSPHERIC REFRACTION D. K. Barton (RCA) p 285–322 refs (See N64-15323 07-15)

12. METEOROLOGICAL SUPPORT TO MISSILE TESTS P. E. Romo p 323–332 (See N64-15324 07-21)

13. CALIBRATION SATELLITE A. Mancini (AFCRL) and D. Brown (Brown Associates) p 339–364 (See N64-15325 07-15)

14. SOME NUMERICAL CHARACTERISTICS OF AN ERROR MODEL BEST ESTIMATE OF TRAJECTORY D. Parks (RCA) p 365–390 refs (See N64-15326 07-20)

N64-15402 California U., Berkeley Lawrence Radiation Lab.

STATUS REPORT, FISCAL YEAR 1963

Edwin M. Mc Millan et al 197 p refs Rept. includes Calif. U., Livermore Lawrence Radiation Lab.

(Supported by AEC)

(*Its* Pub. 48)

The status of the various areas of research activity (physics, chemistry, biology and medicine, biochemistry, nuclear propulsion, weapons, electronic and mechanical engineering, etc.) is presented along with a summary of administration and service activities and a financial summary. P.V.E.

N64-15489 Northeastern U., Boston, Mass.

RESEARCH IN ENERGY CONVERSION Final Report [1 Jul. 1960-30 Sep. 1963]

22 Nov. 1963 312 p refs

(Contract AF 19(604)-7358)

(AFCRL-63-940; AD-429505)

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1. TECHNIQUES FOR FABRICATION OF LARGE, THIN, SILICON SINGLE CRYSTALS W. B. Nowak, R. D. French, and E. C. Steeves p 1–30 refs (See N64-15490 07-25)

2. PROPERTIES OF NITROGEN-SULFUR SYSTEMS R. N. Wiener, S. M. Smith, and D. N. Mitra p 31–109 refs (See N64-15491 07-25)

3. PHOTOCHEMICAL STUDIES OF SOME ORGANIC SULFUR COMPOUNDS AND KETONES K. Weiss, H. Koller, D. H. Lambert, G. P. Rabold, W. M. Moreau et al p 110–259 refs (See N64-15492 07-07)

4. STUDIES ON PLASMAS AND PULSED MAGNETIC FIELD EFFECTS G. Lanza, J. Babakian, J. Davis, T. J. Morin, Jr., and G. R. Peacock p 260–284 refs (See N64-15493 07-24)

5. ELECTRICAL AND OPTICAL PROPERTIES OF SOME METAL CHELATES A. K. Ghosh and S. Chatterjee (AFCRL) p 285–297 refs (See N64-15494 07-23)

N64-15530* National Aeronautics and Space Administration, Washington, D.C.
TALK GIVEN AT HUNTSVILLE, ALABAMA DURING ENGINEERS WEEK [ENGINEERING CHALLENGES OF THE 1960'S]
Elliot Mitchell [1960] 20 p refs
(NASA-TM-X-54545) OTS: $1.60 ph, $0.80 mf

A brief description is given of the National Aeronautics and Space Administration—its facilities, manpower, and budget. The particular role of the NASA facility at Huntsville Alabama is outlined, and some areas are mentioned that are considered as the obligations of engineers and scientists beyond the immediate solving of technical problems. C.L.W.

N64-15563 Martin Co., Baltimore, Md. RIAS Div.
RESEARCH INSTITUTE FOR ADVANCED STUDIES, 1962 [SUMMARY OF YEAR'S ACTIVITIES]
Welcome W. Blender [1962] 68 p refs

Research activities are reported in the following areas: (1) physics—solid state physics, cosmic rays, chemical physics, and theory of particles; (2) biosciences—photosynthetic light reactions; lipid metabolism; effects of high light on the photosynthetic apparatus; biochemistry of senescence in plant cells and primary cell walls and electron microscopy; (3) mathematics—nonlinear oscillations; functional-differential equations; stability and piecewise continuous systems; the construction of Liapunov functions; eventual stability; stability of nonlinear control systems; the theory of systems; identification, observation, and control of linear systems; finite state machines; optimal control theory (random inputs and dynamical systems); generalized curves and the existence of optimal controls; nonlinear optimal control; cross sectioning of dynamical systems; periodic motions on compact manifolds; minimal sets in topological dynamics; topology of factor spaces of solvable lie groups; and summability and Banach limits; (4) metallurgy—embrittlement by liquid metals; phase transformations; lattice imperfections; defects in copper and cadmium; and silver–alumina composites. R.T.K.

N64-15589 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
MILITARY STRATEGY
V. D. Sokolovskiy, ed. 20 Nov. 1962 618 p refs Transl. into ENGLISH of "Voyennaya Strategiya" Moscow, Voyennoye Izd. Min. Oborony SSSR, 1962 458 p
(FTD-TT-62-1289/1+2+3+4; AD-287839)

A short description is given of the development and present state of Soviet military strategy. Areas considered include the development of armed forces, organs and methods of strategic leadership of military forces, and the part played by the various branches of the armed forces in modern warfare. C.L.W.

N64-15638 Bureau of Naval Weapons, Washington, D.C.
RESEARCH AND DEVELOPMENT TO MEET A NATIONAL CAPABILITY
J. P. Craven *In its* Proc. of the 6th U.S. Navy Symp. on Aeroballistics [1963] 5 p (See N64-15626 07-11)

The methods that must be used in developing a successful weapon system (from a research and development standpoint) are discussed. P.V.E.

N64-15674 Hughes Aircraft Co., Culver City, Calif.
CONTRACT PROPOSALS: A SELECTED BIBLIOGRAPHY, 1961-1963
H. D. Hennesy Dec. 1963 8 p refs
(LS-BIB-63-6)

This selected bibliography of contract proposals contains references to periodicals and books. R.T.K.

N64-15707 Thiokol Chemical Corp., Brigham City, Utah Wasatch Div.
WEAPON SYSTEM 133B Wing VI Program Progress Report, 1 Oct.-31 Dec. 1963
E. G. Dorsey, Jr. [1964] 11 p
(Contract AF 04(694)-271)
(AD-422166)

Activities are reported in the following areas:(1) management, planning, and documentation; (2) field support; (3) logistic support;(4) special requirements; (5) flight-test program; and(6) weapon-system safety. R.T.K.

N64-15713 Joint Publications Research Service, Washington, D.C.
NEW DEVELOPMENTS IN THE EARTH SCIENCES
26 Feb. 1964 15 p refs Transl. into ENGLISH of 2 articles from Vestn. Akad. Nauk SSSR (Moscow), no. 12, 1963 p 37–41 and 83–85
(JPRS-23392; OTS-64-21650) OTS: $0.50

CONTENTS:

1. UNDERWATER ROBOTS N. V. Vershinskiy p 1–7 refs (See N64-15714 07-14)

2. THE STUDY OF COSMIC RAYS (CONFERENCE IN MOSCOW) A. A. Pomanskiy p 8–12 (See N64-15715 07-28)

N64-15778 Atomic Energy Commission, Washington, D.C.
FUNDAMENTAL NUCLEAR ENERGY RESEARCH, 1963 [Fourth Annual Research Report]
Dec. 1963 432 p refs
GPO: $2.50

Some of the scientifically interesting advancements of fundamental research in the areas of biology and medicine, physics and chemistry, and nuclear-reactor development are presented. Much of the material contained in this report is of a purely basic-research nature; there is also considerable material that lies in the area between basic and applied research, which is referred to as exploratory development since it involves the linking together of numerous bits of basic scientific information to form a chain of technology that may be of use for a general type of activity after further development. Areas of research include the medical and life sciences, environmental studies, the Plowshare Program and fundamental science, basic physical research, controlled thermonuclear research, and nuclear-reactor research and development. C.L.W.

N64-15903* Northwestern U., Evanston, Ill. Technological Inst.
PROGRAM OF RESEARCH ON THE MANAGEMENT OF RESEARCH AND DEVELOPMENT First Semi-Annual Status Report

Albert H. Rubenstein [1964] 9 p refs
(NASA Grant NsG-495)
(NASA CR-55660) OTS: $1.10 ph, $0.80 mf

Descriptions of and progress in the following studies are presented: (1) Idea Flow in Research and Development, (2) Organization of Research and Development in Decentralized Companies, (3) Organization of Applied Research in Developing Countries, (4) Research and Development Responses to Market Crises, (5) Sources of Research and Development Achievements in Electronics since 1945, (6) A Directory of Research-On-Research, (7) Costs of New Technical Skill Development in Research and Development, (8) Life Histories of Operations Research, (9) Analysis of Rates of Expenditure on Development Projects, and (10) Researchers' Needs for Information. R.T.K.

N64-15994 Union Carbide Nuclear Co., Oak Ridge, Tenn.
Y-12 RADIATION SAFETY MANUAL
P. C. Mc Ree, C. M. West, and J. D. Mc Lendon, ed. 3 Feb. 1964 112 p refs
(Contract W-7405-eng-26)
(Y-1401) OTS: $2.25

It is the policy of the Y-12 plant to protect personnel from exposure to ionizing radiation and/or radioactive materials, industrial toxicants, or other environmental factors that may cause sickness, impair health and well-being, or cause inefficiency among plant workers; to carry on effective monitoring programs; and to encourage the cooperation of all employees involved in effecting ample control programs. A discussion is presented of the ways in which this policy is implemented. R.T.K.

N64-16020 National Aeronautical Lab., Bangalore (India)
ANNUAL REPORT, 1960-61
[1961] 45 p

The most important task concerned the plant layout and design for the wind-tunnel center of the laboratory, of which the 1-foot by 1-foot trisonic wind tunnel is the main research facility. The design and engineering aspects of the various components of the wind tunnel plant, such as the compressor-dryer system, cooling water plant, air-storage system, pressure-regulating valve, settling chamber, supersonic nozzle, transonic test section, model support system, diffuser, optical systems, and data-handling systems were studied. A number of specifications were drawn up in connection with the fabrication and procurement of the equipment required. Prototypes of low-cost windmills were made for experimental tests and demonstration. E.W.

N64-16021 National Aeronautical Lab., Bangalore (India)
ANNUAL REPORT, 1961-62
[1962] 43 p refs

The major part of the work was related to the planning and construction of buildings, the design and fabrication of basic research facilities, equipping the laboratory with apparatus and machinery, recruiting and training scientific staff and technicians, pilot investigations on design and engineering aspects of the 1-ft. and 4-ft. trisonic wind tunnels, and development and utilization of wind power. A 2-in. × 2-in. experimental blow-down facility was designed, fabricated, and commisioned in the Laboratory. A scale model of the electrical and mechanical plant of the Wind Tunnel Centre and the air receiver system was made. Theoretical investigations and engineering studies relating to trisonic wind tunnels, data-handling systems, and wind-power utilization in progress are described. Author

N64-16022 National Aeronautical Lab., Bangalore (India)
ANNUAL REPORT, 1962-63
[1963] 47 p refs

The fabrication of the compressed-air storage system is nearing completion, and the compressor-dryer equipment and ancillaries are under fabrication. Detailed studies of the technical requirements of the 4-ft.-trisonic wind tunnel were conducted, and a comprehensive Project Report prepared. Work on the fabrication of the 1-ft.-trisonic wind tunnel is in progress. The project for installation and maintenance of windmills in suitable sites has made appreciable progress; 27 windmills have already been erected. A countrywide analysis of meteorological data to locate regions where wind energy can be exploited usefully is being made by the Wind Power Division. Author

N64-16047 RAND Corp., Santa Monica, Calif.
CONCEPT AND MEASUREMENT OF DEMAND FOR RECOVERABLE COMPONENTS
Harrison S. Campbell Sep. 1963 23 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-3824-PR; AD-422672)

This report reviews and restates some of the basic concepts bearing on the definition and measurement of demand. The following definition for demand is given: A demand for a recoverable part occurs: (1) if a serviceable unit is installed in place of one that has been removed for maintenance; or (2) if, because no other unit is available, the same unit is repaired and reinstalled, and the delay impairs the base's operational mission. This definition includes, as demands, parts replacement arising from both malfunctions and operational policy. In the recoverable parts area, repair-cycle measurement is closely allied to demand measurement. Essentially, the importance of measuring demand is that it allows an evaluation of the material subsystem in terms of the adequacy of its response. In relating these conceptual requirements to typical maintenance situation, it can be seen that correct demand data will not be a simple byproduct of the AFM 66-1 maintenance data-collection system as it now operates. I.v.L.

02 AERODYNAMICS OF BODIES, COMBINATIONS, AND INTERNAL FLOW

Includes aerodynamics of channels, cowls, ducts, ejectors, nozzles, etc. *For related information see*: 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 11 Fluid Mechanics.

N64-15404* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
LONGITUDINAL AERODYNAMIC CHARACTERISTICS OF BLUNTED CONES AT MACH NUMBERS OF 3.5, 4.2, AND 6.0
J. Wayne Keyes Washington, NASA, Feb. 1964 64 p refs
(NASA TN D-2201) OTS: $1.75

Force and moment data were obtained for a family of low-fineness-ratio blunted-cone configurations. Each configuration had a nose-bluntness ratio of 0 (spherical cap), 0.50, or 0.75, a fineness ratio of 0.50, 0.75, or 1.00, a cone half-angle of 10°, 15°, or 20°, and a flat, convex (23.58° and 40°), concave, or conical (66.42° and 50° half-angle) base shape. The test Reynolds number varied from 2.3×10^6 to 5.5×10^6, based on a 4-in. model base diameter. The results of the investigation indicate

that nose bluntness had little effect on the stability characteristics at angles-of-attack α of 0° and 180°. An increase in fineness ratio or a decrease in cone half-angle resulted in a decrease in stability near $\alpha = 0°$ and had no effect at $\alpha = 180°$. Of the base shapes studied, only the 50° half-angle conical base was unstable at $\alpha = 180°$ for the forebody configuration having a spherical-cap nose, fineness ratio of 1.00, and 15° cone half-angle. Estimated variations of the aerodynamic characteristics with angle-of-attack obtained by means of modified Newtonian theory were in good agreement with the measured results. Author

N64-15636 Lockheed Missiles and Space Co., Sunnyvale, Calif.
HYPERSONIC CYLINDER WAKE STUDIES AT MACH 20
A. C. Brown, R. L. Kramer, and C. E. Smith *In* Bur. of Naval Weapons Proc. of the 6th U.S. Navy Symp. of Aeroballistics [1963] 43 p refs (See N64-15626 07-11)

The initial phase in a study of the fluid mechanical behavior of wakes behind simple bodies is described. Experimental measurements in both the viscous and the inviscid flow-fields of a two-dimensional circular-cylinder model were made in the hotshot tunnel. The free-stream Reynolds number, based on model diameter, was varied between 18,000 and 90,000 at a nominal Mach number of 20. Profiles of pitot pressure, which extended from the axis to the bow shock wave, were measured at four locations behind the model. Schlieren photographs of the bow and wake shock waves were taken. Calculations of the inviscid flow field over the model were made by means of a method-of-characteristics program for comparison with experimental data. An embedded shock wave was inserted numerically in the flow field to simulate the wake shock-wave system. Author

N64-15637 Celestial Research Corp., South Pasadena, Calif.
HYPERSONIC LOW DENSITY WAKES
R. L. Chuan and H. T. Yang (U. of Southern Calif. Eng. Center) *In* Bur. of Naval Weapons Proc. of the 6th U.S. Navy Symp. on Aeroballistics [1963] 41 p refs (See N64-15626 07-11)

Under conditions of high speed and gas rarefaction, the character of the wake behind a body changes significantly from its behavior at normal densities. Analogous to the transition, as the Reynolds number decreases, from the shock-inviscid-boundary-layer flow field to the merged-layer flow field about the nose region of a body in hypersonic flow, there is a transition from the expansion neck recompression to the merged type of flow in the case of the wake. Experimental studies at $M \simeq 6$ and 8.5 with spheres and cylinders at Reynolds numbers down to 1 (Knudsen number $\simeq 10$) have clearly established the transition. At the extremely low density end of the transition, the wake structure resembles that predicted by free-molecule theory. The theory is applicable generally to any convex cylindrical body, and is based on the two-stream, line-of-sight approach of Lees. Author

N64-15644 Naval Weapons Lab., Dahlgren, Va.
CALCULATION OF THE TRANSONIC FLOW ABOUT A BLUNT-NOSED BODY WITH A REAR SKIRT
A. R. Di Donato and B. Zondek (Computer Usage Co.) *In* Bur. of Naval Weapons Proc. of the 6th U.S. Navy Symp. on Aeroballistics [1963] 18 p refs (See N64-15626 07-11)

The direct method of Dorodnitsyn assumes that certain flow quantities can be expressed as polynomials in the direction normal to the body surface. The degree of the polynomial determines the order of the approximation. The partial differential equations are integrated with respect to the distance normal to the body surface and, as a result, are reduced to a system of nonlinear ordinary differential equations. These equations are then integrated numerically, starting at the axis of symmetry, to yield the body pressure distribution, shock wave and sonic line geometries, and the components of velocity in the shock layer. The velocity components, computed along a line normal to the body, are used to build up a right characteristic. The flow downstream from this initial right characteristic is computed by the method of characteristics. An attached shock wave appears at the junction of the skirt and main body. Its geometry and the pressure distribution along the skirt are computed. Author

N64-15664* Iowa State U. of Science and Tech., Ames
ESTIMATION OF THE VELOCITY DISTRIBUTION AT THE INLET OF AN AXIAL-FLOW TURBOMACHINE
J. C. Lysen (Missouri U.) and G. K. Serovy N.Y., Am. Soc. of Mech. Engrs. [1963] 12 p refs Presented at the Winter Ann. Meeting of ASME, Philadelphia, Nov. 17–22, 1963 (NASA Grant NsG-62-60)
(ASME Paper 63-WA-162) ASME: $0.50 members, $1.00 nonmembers

This study investigated factors affecting axial velocity profiles in convergent inlets to axial-flow turbomachines with a view toward improving off-design performance prediction techniques by employment of an actual inlet-velocity profile. A method for estimating this profile was developed and checked experimentally against a simplified inlet section. Author

N64-15732 Canadian Armament Research and Development Establishment, Valcartier
THE GROWTH OF THE TURBULENT INNER WAKE BEHIND A 3 INCH DIAMETER SPHERE
R. Knystautas Feb. 1964 26 p refs
(ARPA Order 133)
(CARDE-TR-488/64)

The width of the turbulent inner wake behind 3-in.-diam. solid aluminum spheres was measured for wake lengths extending up to 1,500 body diameters. The spheres were launched at an initial Mach number of 6 into atmospheric air by a conventional solid propellant gun. The measured growth rate of the turbulent inner wake is in good agreement with the growth rate predicted in the analysis of Lees and Hromas. The agreement is good even to the extent of showing the region of the inflection point in the growth curve beyond which there is an increase in the growth rate. Although the 3-in.-diam. spheres represent a size factor of up to 12 from the spheres launched at other laboratories, no obvious scaling effect is apparent in the growth rate of the turbulent inner wake at this pressure and in this Mach number region. Author

N64-15945 Stanford U., Calif.
A NONLINEAR THEORY FOR SUPERCAVITATING FLOW PAST A WEDGE IN A LONGITUDINAL GRAVITY FIELD
Charles W. Lenau Oct. 1963 112 p refs
(Contract Nonr-225(56); NSF Grant 948)
(Tech. Rept. No. 28; AD-430045)

An analysis is made of the effect of a longitudinal gravity field on two-dimensional supercavitating flow past wedges. Under the assumption that the flow is both irrotational and incompressible, a nonlinear theory is developed for steady flow. A closed, finite cavity model is used. By utilizing the methods of conformal mapping in combination with the Schwarz reflection principle, the mathematical problem is reduced to a three-parameter, nonlinear integral equation with one constraint. The integral equation is derived by reflecting the flow

about the rigid boundaries, and the constraint is obtained by requiring the net singularity strength inside the cavity and wedge system to be zero. A successive-approximation procedure has been devised to obtain a numerical solution of the integral equation. Typical results for the drag-coefficient and cavity dimensions as functions of cavitation and Froude numbers are presented in graphs and tables. Author

N64-15958 Electro-Optical Systems, Inc., Pasadena, Calif.
SOME BASE FLOW CLOSURE ANGLE RESULTS FOR CONES IN FREE FLIGHT
Hartley H. King Jan. 1964 16 p refs
(EOS-RN-21; AD-429792)

Base-flow closure-angle data were obtained from ballistics-range and wind-tunnel photographs of cones in free flight at low supersonic Mach numbers. These data were compared with laminar theory using the Chapman separated-flow model and its recent extensions, which take into account the structure of the initial profiles at the separation point. The ballistics-range data were in good agreement with the theory, which included the effect of distortion of the boundary-layer profiles due to flow turning at the separation point. This suggests that details of the structure of the initial separated shear-layer profiles may be quite important in determining the overall properties of the base-flow region. Author

N64-16043 RAND Corp., Santa Monica, Calif.
SKIN FRICTION AND STABILITY OF A LAMINAR BINARY BOUNDARY LAYER ON A FLAT PLATE
J. F. Gross Jan. 1963 78 p refs Presented at the Mass-Transfer Cooling Symp., Santa Monica, June 1957
(Contract AF 49(638)-700; Proj. RAND)
(RM-3485-PR; AD-295145)

The problem of a laminar boundary layer on a flat plate with mass transfer is studied. Previous work is reviewed, and the fundamental equations are derived. The case of an incompressible laminar boundary layer without heat transfer with hydrogen, carbon dioxide, and iodine injection is solved. Velocity and concentration profiles and skin-friction coefficients are calculated and discussed. It is shown that surface injection of a foreign material into the boundary layer reduces the skin-friction coefficient. The stability of an incompressible laminar boundary layer with mass transfer is estimated using the Lin approximation and is shown to decrease as the molecular weight of the injected substance decreases. Author

N64-16075 Aro, Inc., Arnold Air Force Station, Tenn.
HEAT-TRANSFER AND SHADOWGRAPH TESTS OF SEVERAL ELLIPTICAL LIFING BODIES AT MACH 10
M. E. Hillsamer and J. P. Rhudy Arnold Eng. Develop. Center, Feb. 1964 53 p refs
(Contract AF 40(600)-1000)
(AEDC-TDR-64-19; AD-429931)

Heat-transfer and shadowgraph tests were conducted on several lifting bodies of elliptical cross section and sharp- and blunt-nose shapes to determine heat-transfer distributions and shock-wave shapes around the various configurations. The tests were conducted at a nominal Mach number of 10 and free-stream unit Reynolds numbers of 0.31, 1.00, and 2.38 million per foot over an angle-of-attack range from 0 to 60 deg. Selected results of the tests indicate slight increases in heat-transfer coefficient caused by increased Reynolds number and nose bluntness. Regions of flow separation are also shown on the leeward side of the models at pitch angles of 15 deg. and above. Author

03 AERODYNAMICS OF WINGS, ROTORS, AND CONTROL SURFACES

Includes ailerons; airfoil sections; cascades; fans; flaps; propellers; rotors; slats; spoilers; etc. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; and 11 Fluid Mechanics.

N64-15162* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
PREDICTION OF AERODYNAMIC PENALTIES CAUSED BY ICE FORMATIONS ON VARIOUS AIRFOILS
Vernon H. Gray Washington, NASA, Feb. 1964 21 p refs
(NASA TN D-2166) OTS: $0.50

An empirical equation is developed by which changes in drag coefficients due to ice formations on an NACA 65A004 airfoil may be calculated from known icing and flight conditions; this equation is then extended to include available data for other airfoils with thickness ratios up to 15 percent. The correlation was obtained primarily by use of ice heights and ice angles measured on the 4-percent-thick airfoil. The final equation, however, does not include the ice measurements, but relates changes in drag coefficients due to ice with the following variables: icing time, airspeed, air temperature, liquid-water content, cloud-droplet-impingement efficiencies, airfoil chord, angles-of-attack, and leading-edge radius of curvature. Changes in lift and pitching-moment coefficients due to ice on an NACA 0011 airfoil are also related to the corresponding changes in drag coefficients. Author

N64-15296 Vidya, Inc., Palo Alto, Calif.
THEORETICAL STABILITY DERIVATIVES FOR A DUCTED PROPELLER Interim Report
A. R. Kriebel 18 Oct. 1963 39 p refs
(Contract NOw-62-0129-c)
(AD-428819)

The static force and moment coefficients at angle-of-attack and their dynamic pitching derivatives are given for an isolated ducted propeller. These result from a potential flow analysis that is based upon Fourier expansion of the vorticity distribution. The analysis offers a valid technique for combining existing theory for ring wings at angle-of-attack and ducted propellers in axial flow. The propeller is represented as a uniformly loaded actuator disk and the effects of duct chord-to-diameter ratio, circular arc camber, taper, and thickness are shown for the duct coefficients and their pitching derivatives. Author

N64-15421 General Applied Science Labs., Inc., Westbury, N.Y.
PROPELLER BLADE VIBRATION AND STRESS ANALYSIS Final Report
Edward Lieberman Jun. 1963 80 p refs
(Contract Nonr-3072(00)X)
(Tech. Rept.-283; AD-423377)

An exhaustive series of computer test runs was conducted on a propeller blade configuration that was considered to be representative of blades characterized by severe built-in twist, extremely low aspect ratio, and large overhang of thin leading and trailing edges. The results of the runs made by the vibration program indicate conclusively that it is necessary to prescribe a large number of degrees of freedom to obtain satisfactory results for this type of blade. An IBM 7090 program

was designed to accommodate up to 108 degrees of freedom, which corresponds to a production machine time of approximately 1 1/2 hours. This limit was imposed by the storage capability of the computer, as well as by economic considerations with respect to cost of machine time to complete a single run. For the great majority of blade configurations, it is believed that the present program will generate accurate estimates of the natural frequencies. R.T.K.

N64-15595 Southwest Research Inst., San Antonio, Tex.
EXPERIMENTAL DETERMINATION OF OSCILLATORY LIFT AND MOMENT DISTRIBUTIONS ON SURFACE-PIERCING FLEXIBLE HYDROFOILS
Guido E. Ransleben, Jr. 2 Dec. 1963 69 p refs
(Contract Nonr-3335(00))
(AD-422754)

Measured spanwise distributions of oscillatory lift and moment of surface-piercing cantilever subcavitating hydrofoils are presented. The hydrofoils were of aspect ratio 5 rectangular planform, 65.5% submerged. The data are compared with measured data from the same models fully submerged. Author

N64-15627 David Taylor Model Basin, Washington, D.C.
OPTIMUM LEADING EDGES AT HIGH SPEEDS, PHASE I
Roger J. Furey *In* Bur. of Naval Weapons Proc. of the 6th U.S. Navy Symp. on Aeroballistics [1963] 20 p refs (See N64-15626 07-11)

Results of heat-transfer and pressure-distribution tests on two hemisphere-cone models at Mach numbers of 5 and 10 and an approximate Reynolds number range (using model base diameter as reference length) between 10^5 and 1.5×10^5 are presented. The results point out the direct conflict that arises when an attempt is made to minimize the local skin temperature in the stagnation region by varying the leading-edge radius while maintaining the pressure drag within acceptable limits. To aid in determining an optimum leading-edge shape, a computer program capable of predicting both heat transfer and pressure distribution on blunt leading edges was developed and utilized. Author

N64-15628 Naval Missile Center, Point Mugu, Calif.
ESTIMATION OF THE LIFT CHARACTERISTICS OF VERY LOW ASPECT RATIO WINGS AT SUBSONIC SPEEDS
A. F. Lampros *In* Bur. of Naval Weapons Proc. of the 6th U.S. Navy Symp. on Aeroballistics [1963] 13 p refs (See N64-15626 07-11)

A simple method of estimating the lift characteristics of very-low-aspect-ratio wings at subsonic speeds is described. The method was derived from existing linear wing theory and nonlinear rectangular wing theory. Comparison of the method with available wind-tunnel test data indicates that the lift curves and centers of pressure of some very-low-aspect-ratio wings can be estimated with a degree of accuracy suitable for preliminary design purposes. Author

N64-15634 Martin Co., Baltimore, Md.
A TRANSONIC EXPERIMENT AT HYPERSONIC SPEED
S. C. Traugott *In* Bur. of Naval Weapons Proc. of the 6th U.S. Navy Symp. on Aeroballistics [1963] 25 p refs (See N64-15626 07-11)

Cylindrically blunted wedges were tested in a hotshot tunnel at various angles-of-attack. The geometry was so arranged that the sonic point occurred either on the nose or much further downstream on the corner terminating the body, depending on angle-of-attack. Both surface pressures and shock shapes were obtained over the range in incidence associated with this large change in sonic-point body thickness. The rearward shift of the sonic point was found to have very little effect on the flow for a relatively slender blunted wedge. The role of asymmetry in the stagnation region was explored by comparing a nonslender blunted wedge at small incidence to the slender wedge at large incidence. Author

N64-15826 Thurston Erlandsen Corp., Sanford, Me.
FLIGHT TEST OF THE HYDRO-SKI RESEARCH VEHICLE HR V-1 EQUIPPED WITH THE PBM TYPE SKI Final Summary Report
David B. Thurston 25 Nov. 1963 37 p
(Contract N600(19)59309)
(TEC-6302-4; AD-429303)

Presented are performance characteristics, water loadings, and design impressions obtained during evaluation of a one-third-scale hydro-ski mounted on the HRV-1 amphibian aircraft. Flight test work included taxi, takeoff, and landing runs at various gross weights, ski extensions, ski areas, wind conditions, and sea states. Recorded data includes axial, drag, lateral, and torsional loadings; airplane pitch and speed; and moving pictures of the HRV-1 and ski. C.L.W.

N64-15944 Stanford U., Calif.
CAVITY FLOW AROUND CAMBERED HYDROFOILS
Ahmed El Nimr and Byrne Perry Sep. 1963 44 p refs
(Contract Nonr-225(56))
(Tech. Rept. 17; AD-429509)

An analytical study is made of the flow past hydrofoils with large camber at arbitrary angles-of-attack. The class of hydrofoils considered is restricted to those whose hodograph plane has a shape very near that bounded by two circular arcs. Under this assumption, a general method is derived to calculate the parameters of the flow. In addition, a shortcut procedure is introduced for estimating the lift and drag coefficients. As a numerical example to illustrate the theory, the flow past a circular-arc foil is considered. The force coefficients are in good agreement with the values computed by Rosenhead. Author

N64-15973* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
HEAT TRANSFER TO A DELTA-WING-HALF-CONE COMBINATION AT MACH NUMBERS OF 7 AND 10
James C. Dunavant Washington, NASA, Mar. 1964 33 p
(NASA TN D-2199) OTS: $1.00

An investigation has been conducted on a delta-wing–half-cone combination at Mach numbers of 7 and 10 through an approximate angle-of-attack range from $-5°$ to $30°$. The results of this investigation showed no effect of any shock from the cone on the wing surface pressures or heat transfer. The heat transfer to the stagnation line of the cone is little affected by the presence of the wing. The heat transfer to the wing surface showed agreement with the appropriate laminar or turbulent theory using measured pressures and based on a strip type of flow from the leading edge. Transition, which may be the result of the vortex near the corner, was observed at Reynolds numbers of less than 0.5×10^6. Author

N64-15974* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THE AERODYNAMIC DESIGN OF WINGS WITH CAMBERED SPAN HAVING MINIMUM INDUCED DRAG
Clarence D. Cone, Jr. Washington, NASA, 1963 29 p refs
(NASA TR R-152) GPO: $0.35

The general relations needed for the design of airfoils with arbitrary spanwise camber and with minimum induced drag for specified flight conditions are developed. Relations are also presented for determining the wing form necessary for maximum lift–drag ratio at cruise by optimizing the wing with respect to both profile and induced drag. Sample calculations are carried out for a circular-arc wing. The basic equations needed for determining the pitching moment of cambered-span wings at design flight conditions are also presented for use in the analysis of trim requirements at cruise for complete aircraft. Author

N64-16061 Minnesota U., Minneapolis Aero Hypersonic Lab.

EXPERIMENTAL PRESSURE AND HEAT TRANSFER DISTRIBUTIONS ON BLUNT-NOSE DELTA WINGS FOR ANGLES OF ATTACK UP TO 30° AT MACH NUMBER 7 Final Report

R. D. Archer, W. L. Melnik, and R. Hermann Wright-Patterson AFB, Ohio, Aerospace Research Lab., Dec. 1963 226 p refs (Contract AF 33(616)-7402)
(ARL-63-231; AD-430711)

Surface pressure and aerodynamic heat-transfer distributions measured over slender blunt-nosed delta wings of elliptic cross section are presented for Mach number 6.8 with unit Reynolds of 2 and 4×10^4 per inch over an angle-of-attack range from 0° to 30°. The basic shapes of the delta wings consisted of elliptic cones having a 5 to 1 ratio major to minor axis. The effect of leading-edge sweep angle was obtained with models having 70° and 80° sweepback. A significant dependence on Reynolds number was observed in the surface pressure and heat-transfer distributions, especially for increasing angles-of-attack. Fluid properties on the windward surfaces of the delta wings were strongly influenced by boundary-layer separation on the leeward side. Aerodynamic heat-transfer distributions exhibited an abrupt change with leading-edge sweep for the conditions of these experiments. Author

04 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc., and specific types of complete aircraft (e.g., Ground Effects Machines, Flexible Wings, STOL, and VTOL); flight tests; operating problems; safety devices; and stability and control. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 30 Space Vehicles.

N64-15222* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

PERFORMANCE CHARACTERISTICS OF A PREFORMED ELLIPTICAL PARACHUTE AT ALTITUDES BETWEEN 200,000 AND 100,000 FEET OBTAINED BY INFLIGHT PHOTOGRAPHY

Charles H. Whitlock and Harold N. Murrow Washington, NASA, Feb. 1964 27 p refs
(NASA TN D-2183) OTS: $0.75

The performance characteristics of a preformed elliptical parachute at altitudes between 200,000 and 100,000 feet have been obtained by means of in-flight photography. It was demonstrated that this type of parachute will open at altitudes of about 200,000 feet if conditions such as twisting of the suspension lines or draping of the suspension lines over the canopy do not occur. Drag-coefficient values between 0.6 and 0.8 were found to be reasonable for this type of parachute system in the altitude range between 200,000 and 100,000 feet. Author

N64-15261 Cook Electric Co., Morton Grove, Ill. Tech-Center Div.

EVOLUTION OF THE HYPERFLO PARACHUTE

L. W. Sims *In* AF Systems Command Trans. of the 8th Symp. on Ballistic Missile and Space Technol., Vol. 2 [1963] p 231–262 refs (See N64-15251 07-01)

Analytical and experimental studies of the characteristics of supersonic parachutes and associated phenomena, which resulted in the development of the Hyperflo parachute, are described. Data from wind-tunnel test programs that were conducted with 6- and 8-in. parachute models are discussed. These programs covered the Mach number range from 1.5 to 4.65 and included approximately 200 test conditions. The present paper describes the evolution of parachute canopies that performed satisfactorily through Mach 4.65 and, in a succeeding series of wind-tunnel tests, through Mach 6. Results of a rocket-sled test program and a free-flight program to test full-scale Hyperflo parachutes up to Mach numbers of 4.0 and altitudes of 130,000 feet are summarized. Author

N64-15273* National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.

CONTRIBUTIONS OF THE X-15 PROGRAM TO LIFTING ENTRY TECHNOLOGY

Euclid C. Holleman and Elmor J. Adkins N.Y., Am. Inst. of Aeron. and Astronautics [1964] 12 p refs Presented at the AIAA Aerospace Sci. Meeting, N.Y., 20–22 Jan. 1964
(AIAA Paper 64-17) AIAA: $0.50 members, $1.00 nonmembers

The entry-research potential of the X-15 is illustrated by comparing its velocity with that of an orbital lifting-entry vehicle having similar characteristics, i.e., a lift-to-drag ratio of 1 to 2 and a wing loading of 75 psf. The X-15 flight envelope adequately covers the altitude and lower speed range. Piloting experience has been obtained with the X-15 in regions of essentially zero dynamic pressure and regions of high dynamic pressure, up to about 2,000 psf. Control in the regions of low and high dynamic pressure is discussed, and based on this experience, the control-system requirements for lifting entry are suggested. Also, the operational experience obtained during terminal guidance, navigation, and landing of the X-15 that is applicable to lifting entry vehicles is discussed. R.T.K.

N64-15330* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

ANALYTICAL STUDY OF AIRCRAFT-DEVELOPED SPINS AND DETERMINATION OF MOMENTS REQUIRED FOR SATISFACTORY SPIN RECOVERY

Ernie L. Anglin and Stanley H. Scher Washington, NASA, Feb. 1964 88 p refs
(NASA TN D-2181) OTS: $2.25

An analytical study has been made of fairly steady developed spins and recoveries of a sweptback-wing aircraft configuration by using rotation-balance aerodynamic wind-tunnel data and a digital computer. Changes in aerodynamic, inertia, and relative-density factors resulted in varied spins from which recoveries were attempted by applying an external antispin yawing or rolling moment. In order to indicate the relative difficulty of spin recovery, a nondimensional spin-energy factor based on the kinetic energy of spin rotation was devised. The antispin yawing-moment coefficient required to provide a satisfactory recovery is shown to be related to this

factor. The antispin rolling-moment coefficient required to provide a satisfactory recovery was found to depend on both this spin-energy factor and upon the moment of inertia about the longitudinal axis. A method is also presented for estimating the approximate nature of steady developed spin characteristics by using certain aerodynamic and inertia factors. Author

N64-15596 Douglas Aircraft Co., Inc., Long Beach, Calif.
A STUDY OF ROUGH-TERRAIN-INDUCED STRUCTURAL LANDING LOADS
John E. Yeates and James G. Mc Hugh Ft. Eustis, Va. Army Transportation Res. Command, Dec. 1963 176 p refs
(Contract DA-44-177-TC-735)
(TRECOM-TR-63-68; AD-430063)

This report contains an analytical investigation of the effect of rough terrain on the loads, weights, and performance of the OV-1 airplane during landings. The load calculations, which were conducted on an IBM 7090 computer, considered the internal operating mechanism of the landing gear and the flexibilities of the gear and structure as a mutually interacting dynamic system. A determination was made of the terrain roughness at which modification to the airplane was considered necessary and the terrain roughness at which the reduced performance of the OV-1 airplane, due to increased weight, became equal to or inferior to a VTOL aircraft of equal weight. This work was concerned with the determination of maximum loads and corresponding weight and performance penalties; however, observations were made regarding the importance of repeated loads during landing or taxiing on surfaces with multiple irregularities. Author

N64-15682 Chance Vought Corp., Dallas, Tex. Aeronautics and Missiles Div.
MODEL F-8E AIRPLANES Flight Test Summary Report for Period Ending 31 Jan. 1964
R. R. Reed, Jr. 13 Feb. 1964 8 p
(Contract 62-0379; Contract 63-0510)
(FT(F-8)-308)

Flight summaries are presented for the YTF-8A and F-8E airplanes, and results of compatibility evaluation tests of the AN/APQ-104 and Radar-Matra are given. R.T.K.

N64-15706 Hydronautics, Inc., Laurel, Md.
MINIMUM WAVE RESISTANCE OF BULBOUS SHIPS
B. Yim Oct. 1963 53 p refs
(Contract Nonr-3349(00))
(Tech. Rept. 117-3; AD-429767)

The usefulness of the bulb to a ship is known to be mainly in the cancellation of the ship wave height by virtue of the phase difference between the ship waves and bulb waves. The bulb is usually represented by a point doublet, whereas the ship is represented by a source distribution on the vertical center plane of the ship. In this report, the ship is considered to be symmetric and is expressed as a polynomial. The doublet distribution and the quadrupole distribution are also expressed in polynomials along the straight front perpendicular of the bow. A sine ship and a parabolic ship are considered, and the optimum doublet and quadrupole distributions are calculated. The bow wave resistances with and without bulbs are evaluated. The problem of minimum bow (or stern) wave resistance associated with bulbs is attempted, and the effect of shoulder waves is discussed. E.W.

N64-15804 American Power Jet Co., Ridgefield, N.J.
PERFORMANCE OF AND DESIGN CRITERIA FOR DEPLOYABLE AERODYNAMIC DECELERATORS
George Chernowitz and James H. De Weese (ASD) Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Dec. 1963 540 p refs Information covers thru mid-1962 and is the 2d major rev. of the USAF Parachute Handbook
(Contract AF 33(616)-8112)
(ASD-TR-61-579; AD-429921)

The present state-of-the-art, technology, and theory applicable to deployable aerodynamic decelerators, especially textile parachute canopies, are presented. Major types of decelerators are described, and their aerodynamic and operational characteristics, as well as applications, are discussed. Detailed coverage is given to decelerator materials, design and construction, hardware, test methods and vehicles, and test instrumentation. Decelerator design procedures and performance prediction techniques are demonstrated by sample calculations. Author

N64-15824 Stevens Inst. of Tech., Hoboken, N.J.
SUMMARY OF INVESTIGATION OF MIDSHIP BENDING MOMENTS EXPERIENCED BY MODELS IN EXTREME REGULAR WAVES Final Report
John F. Dalzell 18 Dec. 1963 23 p refs
(Contract NObs-88509)
(SSC-157; PB-181510; AD-42901) OTS: $0.75

This report summarizes experimental research to investigate the possibility of a physical upper limit on midship bending moments being reached in regular waves of height significantly less than the theoretical upper limit of stability for progressive waves ($h/\lambda = 1/7$). The experiments included variation of ship type, of distribution of loading, and of freeboard as model parameters. Each model was tested at various speeds in regular head and following waves of several different lengths and of a wide range of heights. No significant upper limit of bending moment was found. However, the study establishes more firmly the grossly linear dependence of midship bending moment on wave height, even for extreme wave heights that may be encountered in service. Author

N64-16062 ARO, Inc., Arnold Air Force Station, Tenn.
FORCE AND PRESSURE TESTS OF AN AGARD CALIBRATION MODEL B AT A MACH NUMBER OF 10
R. K. Matthews and L. L. Trimmer Arnold Eng. Develop. Center, Feb. 1964 36 p refs
(Contract AF 40(600)-1000)
(AEDC-TDR-64-31; AD-430701)

The AGARD Calibration Model B, with and without wings, was tested at a nominal Mach number of 10. Force and moment coefficients were obtained over a range of pitch and yaw angles from −5° to 15.5° with a Reynolds number range from 1.10×10^6 to 9.80×10^6, based on model length. The lift-curve slope, aerodynamic center, and drag coefficients show excellent correlation with data from other tunnels at various Mach numbers. Author

05 ASTRONOMY AND ASTROPHYSICS

Includes celestial mechanics; and radioastronomy. *For related information see*: 12 Geophysics, and 29 Space Sciences.

N64-15156 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
NOTES FROM OBSERVATORIES ON THE CONTINUOUS SPECTRUM OF VENUS AND JUPITER
Hyron Spinrad Repr. from Publ. Astron. Soc. Pacific v. 74, no. 437, Apr. 1962 p 156–158 refs

Empirical data on intensity distribution in the spectrum of Venus and of Jupiter are discussed. The available data do not corroborate the hypothesis that suggests nitrous oxide as being responsible for the low-ultraviolet albedoes of these two planets. Eight exposed and widened 100-inch coude' spectrograms in the near-blue region were traced with a microphotometer. The linear dispersion was about 3 A/mm at Hγ, thus the resolution is an order of magnitude superior to Kozyrev's. The tracings of Venus and the Moon are very similar in the λ4372 region; the absorption band found there by Kozyrev is not present on the eight spectrograms. It was concluded that the λ4372 band is absent from the Cytherean spectrum, at least for phases greater than 50°. Calibrated medium-dispersion spectrograms of Jupiter and the Moon showed that the blue and near-ultraviolet regions of Jupiter to about λ3500 were not depressed as compared to the lunar spectrum. One uncalibrated medium-dispersion Lick spectrogram of Jupiter showed a broad, shallow absorption dip from about λ3900 to λ3500. Other Jovian spectra had slightly weakened ultraviolet continua as compared to the Moon. I.v.L.

N64-15157* Massachusetts Inst. of Tech., Cambridge
RADIO OBSERVATIONS OF OH IN THE INTERSTELLAR MEDIUM
S. Weinreb, A. H. Barrett, M. L. Meeks, and J. C. Henry Repr. from Nature v. 200, no. 4909, Nov. 1963 p 829–831 refs (See N64-11379 02-28)
(NASA Grant NsG-419)

The detection of 18-cm absorption lines of the OH radical in the radio absorption spectrum of Cassiopeia A is reported, as evidenced by the following: (1) Lines at both 1,667 mc/sec and 1,665 mc/sec have been detected with frequencies and intensity ratios that are in good agreement with the expected values. (2) The OH absorption spectra at both frequencies show general agreement with the H absorption spectra. (3) The absorption lines disappear when the antenna is positioned off Cassiopeia A by one degree in both azimuth and elevation. (4) The lines shifted 20 kc/sec between October 17 and October 29, 1963. This is the shift expected from the orbital velocity of the earth during this time interval. The OH/H abundance ratio can be calculated from the results of the H absorption on Cassiopeia A, with typical ratios of 1×10^{-7} being obtained. Observations made have also enabled a more accurate determination of the two strongest λ-type doublet lines of OH. These are: $F = 2 \rightarrow 2$ with a laboratory measurement of 1,667,340 ± 30 kc/sec and an astronomical measurement of 1,667,357 ± 7 kc/sec, and $F = 1 \rightarrow 1$ with a laboratory measurement of 1,665,460 ±100 kc/sec and an astronomical measurement of 1,665,402 ±7 kc/sec. I.v.L.

N64-15174 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena Space Sciences Div.
THE STELLAR CONTENT OF NGC 3379
Hyron Spinrad Repr. from Publ. Astron. Soc. Pacific, v. 74, no. 437, Apr. 1962 p 146–150 refs

Measurements of the mass-luminosity ratio of NGC 3379 were an order of magnitude higher than the value found for the solar vicinity, indicating a basic difference in the stellar populations involved. A crude stellar synthesis of the galaxy was constructed from spectral features and color observations. E.W.

N64-15196 Minneapolis-Honeywell Regulator Co., Minn. Military Products Group
PRECISION DETERMINATION OF THE POSITION OF THE CENTER OF THE MOON'S MASS FROM PHOTOGRAPHIC OBSERVATIONS
N. F. Bystrov [1962] 13 p refs Transl. into ENGLISH of an article from Astron. Zh. (Moscow), v. 39, no. 3 p 527–531 (MH Transl. 401)

Factors that influence the precision of the photographic determination of coordinates of the center of the moon's mass are investigated. The results of visual and photoelectric measurements of photographs of the moon are compared. A method is proposed for obtaining the position of the center of the moon's mass relative to details on the disk. Author

N64-15268 Tokyo Astronomical Observatory (Japan)
ANNALS OF THE TOKYO ASTRONOMICAL OBSERVATORY, UNIVERSITY OF TOKYO, SECOND SERIES, VOLUME 8, NO. 2
1963 27 p refs

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1. ON PHYSICAL CONDITIONS IN THE CORONA ABOVE AN ACTIVE REGION REFERRING TO THE RADIO OBSERVATIONS M. Morimoto p 125–144 refs (See N64-15269 07-28)
2. PROPER MOTIONS OF THE STARS USED IN THE POLAR TUBE OBSERVATIONS OF THE TOKYO ASTRONOMICAL OBSERVATORY N. Sekiguchi, J. Matsumoto, and F. Nemichi p 145–149 refs (See N64-15270 07-05)

N64-15270 Tokyo Astronomical Observatory, (Japan)
PROPER MOTIONS OF THE STARS USED IN THE POLAR TUBE OBSERVATIONS OF THE TOKYO ASTRONOMICAL OBSERVATORY
Naosuke Sekiguchi, Jun'itsu Matsumoto, and Fumiko Nemichi *In its* Ann. of the Tokyo Astron. Obs., 2d Ser., v. 8, no. 2, 1963 p 145–149 (See N64-15268 07-05)

Proper motions of the 10 polar stars used in the Polar Tube observations of the Tokyo Astronomical Observatory are determined and compared with recent plates of the polar region photographed with the 20-cm Brasher Astrograph and with the Polar Tube. For accurate position determinations, the Zweiter Katalog der Astronomischen Gesellschaft is used. Equations used in the determination are presented. Author

N64-15277 Georgetown U., Washington, D.C. Georgetown College Observatory
THE TOOLS OF THE MODERN ASTRONOMER
Francis J. Heyden *In its* Recent Advances in Astro-Geophysics [1961] p 1–7 (See N64-15276 07-01)

A discussion is presented of the new methods of research that are available to the astronomer of today. The abundance of information to be gathered demonstrates the need for faster methods of reduction by electronic computer. R.T.K.

N64-15278 Georgetown U., Washington, D.C. Georgetown College Observatory
ASTROPHYSICAL RESEARCH WITH HIGH DISPERSION INSTRUMENTS
Carl C. Kiess *In its* Recent Advances in Astro-Geophysics [1961] p 8–12 (See N64-15276 07-01)

The following are discussed: (1) instruments—the spectroscope and the spectrograph; (2) astronomical spectrum analysis; (3) photographic plates; and (4) recent applications in studies of Jupiter, Mars, and Venus. R.T.K.

N64-15284* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
TEKTITES AND THE MOON
John A. O'Keefe *In* Georgetown U., Washington, D.C. Recent Advances in Astro-Geophysics [1961] p 60–65 (See N64-15276 07-01)

A review of theories concerning the origins of tektites is presented. The conclusions that may be made concerning the moon as a place of origin for the tektites are included. R.T.K.

N64-15285 Naval Observatory, Washington, D.C.
LUNAR MAPPING PROBLEMS
Chester B. Watts *In* Georgetown U., Washington, D.C. Recent Advances in Astro-Geophysics [1961] p 66–69 refs (See N64-15276 07-01)

Maps of the moon's surface have been in existence for a long period of time, showing the locations of physical features in a system of spherical coordinates. Measures of the elevation of the features have also been obtained but, in general, with respect only to neighboring points. The lack of a datum analogous to the surface of the oceans of the earth has presented a serious obstacle to further progress. The means available for solving this problem and the conditions affecting it are reviewed. R.T.K.

N64-15286 Georgetown U., Washington, D.C. Georgetown College Observatory
COMETS
Carl C. Kiess *In its* Recent Advances in Astro-Geophysics [1961] p 70–72 (See N64-15276 07-01)

Comets moving in ellipses are described as being members of the solar system. The question of their origin—whether or not they were always members of the solar system—is considered. The structure and physical nature of comets as determined by photometry and spectroscopic observations are discussed. Comets may give information concerning the primitive state of the solar system and, possibly, of the medium through which the sun and its planets are moving. R.T.K.

N64-15287 National Bureau of Standards, Washington, D.C.
PHYSICS OF THE SUN
Charlotte E. Moore *In* Georgetown U., Washington, D.C. Recent Advances in Astro-Geophysics [1961] p 73–78 refs (See N64-15276 07-01)

The topics discussed are: (1) the sun as a star—the solar constant, mass, and chemical composition; (2) observed solar phenomena—properties of this star; (3) studies of solar radiation with the spectroscope; and (4) a solar model. R.T.K.

N64-15288 Michigan U., Ann Arbor
INFRARED TECHNIQUES IN ASTROPHYSICS
George J. Zissis *In* Georgetown U., Washington, D.C. Recent Advances in Astro-Geophysics [1961] p 79–93 refs (See N64-15276 07-01)

The advances that have been made in the technology for work with electromagnetic radiation in the infrared spectral region are discussed. Instruments are available having an improvement of several orders of magnitude in speed of response and sensitivity. Infrared technology is reviewed, and a brief discussion is presented of some infrared problems in astrophysics and related fields. R.T.K.

N64-15289* National Aeronautics and Space Administration, Washington, D.C.
RADIOASTRONOMICAL OBSERVATIONS OF THE MOON AND PLANETS
John P. Hagen *In* Georgetown U., Washington, D.C. Recent Advances in Astro-Geophysics [1961] p 94–104 (See N64-15276 07-01)

The following are discussed: (1) radio observations of the Moon and of the planets—beam width, gain, receivers, characteristics of signals, and radar astronomy; and (2) radio radiation from the Moon and planets—Moon, Venus, Mars, and Jupiter. The relation of the signal power from the planet to the background-noise power of the receiver output terminal is included. R.T.K.

N64-15290 Georgetown U., Washington, D.C. Georgetown College Observatory
DISTRIBUTION OF STARS
Francis J. Heyden *In its* Recent Advances in Astro-Geophysics [1961] p 105–110 (See N64-15276 07-01)

A review is presented of the contributions of the radio and the visual astronomer to the knowledge of the galaxy of stars of the Milky Way, the Andromeda galaxy, and interstellar material. R.T.K.

N64-15310* National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York, N.Y.
NEUTRINO EMISSION, MASS LOSS, AND THE FREQUENCY OF SUPERNOVAE
Richard Stothers Repr. from Astrophys. J., v. 138, no. 4, 15 Nov. 1963 p 1085–1089 refs

Without steady mass loss during the red-giant phase, most stars with mass above the Chandrasekhar limit should evolve into Type II supernovae, but the predicted number of supernovae is much larger than the observed number. Although mass loss considerably lowers the predicted number, its effect will be reduced because of neutrino emission, which decreases the time scale of the late phases. However, by use of presently known rates of stellar evolution and mass ejection, it is shown that loss of mass with or without neutrino emission will roughly account for the observed number of Type II supernovae. Thus neutrino emission is not contradicted by observations of supernova frequency. Author

N64-15538* Boston U., Mass.
CATALOG OF LUNAR CRATERS V
Gerald S. Hawkins, Peter W. Mitchell, and David D. Friesen Dec. 1963 19 p refs
(NASA Grant NsG-246-62)
(NASA CR-55547; Res. Rept. 13) OTS: $1.60 ph, $0.80 mf

This catalog gives the selenographic coordinates of all craters observable on a selected portion of the moon's surface. The diameter of the crater, together with comments on shape, is also given. Approximately 25 percent of the craters have been measured previously by other observers. The catalog gives the position found in the present series of measurements and the name adopted by the International Astronomical Union. Author

N64-15548* RAND Corp., Santa Monica, Calif.
STATISTICAL ANALYSIS OF ASTRONOMICAL UNIT ESTIMATES
Albert Madansky and Allan Marcus Jan. 1964 28 p refs
(NASA CR-55541; RM-3940-NASA) OTS: $2.60 ph, $1.04 mf

In determining the astronomical unit, (1) any neglect of the possible correlation of errors may result in an underestimate of the standard deviation of the au estimate; (2) an estimate of the parameters of primary interest with small variance may be based on a least-squares fit using reasonable assumed values of the additional parameters as constants, rather than including them in the fit; and (3) the variance of an au estimate may be estimated validly from a single observation of a related phenomenon (e.g., distance from Earth to Venus), provided that the variance of that particular observation is known. Author

N64-15601* Armagh Observatory (Northern Ireland)
PHOTOMETRY, DIMENSIONS, AND ABLATION RATE OF COMETS
E. J. Öpik Repr. from Irish Astron. J. (Armagh), v. 6, no. 3, Sep. 1963 p 93–112 refs
(NASA Grant NsG-58-60)
(*Its* Contrib. No. 42)

On account of the peculiarities of distribution of light in the coma, the estimated brightness of comets varies inversely as the first power of distance from the observer, instead of the traditionally used second power. The effect is of moderate importance for natural comets, but very large for artificial comets. The almost sudden appearance of the radicals and ions in cometary envelopes points to an active shell, possibly a kind of radiation belt surrounding the nucleus. Formulas for absolute magnitudes and photometric radii of comets are given and confirmed by recoil radii. These are very much smaller than the dimensions of "false nuclei" observed telescopically. The total evaporation rate of the nuclear ices is estimated; the luminescent radicals (C_2, CN) and ions (CO^+) account for nearly 1% of the total gaseous mass. The layered mechanism of simultaneous evaporation of constituents of very different volatility is discussed. From the low mean molecular weight (7 to 8) of the gases, as well as from cosmogonic considerations, it appears that solid hydrogen must be an important constituent of comet nuclei. Author

N64-15783* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
RELATIONSHIP BETWEEN THE SYSTEM OF ASTRONOMICAL CONSTANTS AND THE RADAR DETERMINATIONS OF THE ASTRONOMICAL UNIT
Duane O. Muhleman 15 Jan. 1964 24 p refs
(NASA Contract NAS7-100)
(NASA CR-53066; JPL-TR-32-477) OTS: $2.60 ph, $0.92 mf

This report discusses the work of Newcomb and de Sitter from the standpoint of the definitions of the fundamental constants and the theoretical relationships between them. These theoretical relationships are applied to the radar results when possible. The main body of the report is devoted to a brief but exact discussion of the determination of the astronomical unit with radar and to an extensive error analysis of the technique. Author

N64-15809 Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
TEKTITES: A BIBLIOGRAPHY
Charlotte F. Shenk 15 Jan. 1964 122 p refs
(RSIC-107; AD-430350)

This bibliography consists of 771 references on tektites and some closely related subjects. Many entries are annotated, giving information about tektite origins, composition, discovery sites, ages, formation, and history. The material gathered is international in scope, covering the literature from the early 19th century through 1963. Titles and other bibliographical data generally appear in the languages of origin. Author

N64-15900* Boston U., Mass.
CATALOG OF LUNAR CRATERS IV
Gerald S. Hawkins, Peter W. Mitchell, and David D. Friesen 12 Dec. 1963 21 p refs
(NASA Grant NsG-246-62)
(NASA CR-55536; Res. Rept. 12) OTS: $2.60 ph, $0.83 mf

This catalog gives the selenographic coordinates of lunar craters. The diameters of the craters, together with comments on shape, are also given. Approximately 25 percent of the craters have been measured previously by other observers. The catalog gives the positions found in the present series of measurements and the name adopted by the International Astronomical Union. R.T.K.

N64-15924* California Inst. of Tech., Pasadena
NEW MEASUREMENTS OF STEEP LUNAR SLOPES
Howard A. Pohn Repr. from Publ. Astron. Soc. Pacific, v. 75, no 443, Apr. 1963 p 186–187 refs
(NASA Grant NsG-56-60)

A report is presented of investigations of the moon from phase angles of −25° to +25°, using the Mount Wilson 60-inch telescope. These studies have yielded high values for the steepness of lunar crater slopes. A group of 19 craters was selected so as to give a maximum distribution in latitude and longitude, and the measurements made of these craters are included. R.T.K.

N64-15932 Michigan U., Ann Arbor
PHYSICS OF NONTHERMAL RADIO SOURCES
Stephen P. Maran Repr. from Phys. Today, v. 16, no. 11, Nov. 1963 p 33–35 refs

The fundamental observational problem in radioastronomical investigations of discrete sources—objects located outside the solar system—is discussed. This problem is the determination of the precise positions and spectra of these objects, as well as measurement of the brightness distributions of those sources large enough to be resolved by existing equipment. Polarimeter measurements at a number of frequencies have been made and have provided data on the percentage of linear polarization and position [angle of the electric vector for some of the more intense sources. The determination of precise positions for radio sources has facilitated the use of powerful optical telescopes to discover the galaxy, ionized hydrogen cloud, gaseous remnant of a supernova explosion, or other objects responsible for radio emission. R.T.K.

N64-15971* National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York, N.Y.
DEPARTURES FROM LOCAL THERMODYNAMIC EQUILIBRIUM IN AN AO STAR ATMOSPHERE
Myron Lecar Washington, NASA, Mar. 1964 114 p refs
(NASA TN D-2110) OTS: $2.50

By comparison with an accurate model, departures from local thermodynamic equilibrium (LTE) have been evaluated for model atmospheres in radiative equilibrium, approximating an AO star (pure hydrogen, $T_{eff.} = 10^{4\circ}$ K, $g = 10^3$ and 10^4 cm sec^{-2}). The non-LTE atomic populations depress the emergent flux in the Lyman continuum and in the lines by 10 to 30 percent, but the Balmer and higher continua are unaffected. Thus the temperature stratification is unchanged. The emergent flux in the center of the lines is insensitive to replacing a 5-point quadrature over a Doppler profile by the central intensity. At the surface, the lowest three bound states are overpopulated, the higher bound states are underpopulated, and the degree of ionization is reduced by a factor of 2 with respect to LTE. Author

N64-15996 Chicago U., Ill. Labs. for Applied Sciences
DIFFUSE REFLECTION IN THE 2.7μ REGION FROM A PLANE-PARALLEL HOMOGENEOUS CLOUD
Charlotte E. Bartky Sep. 1963 42 p refs
(ARPA-SD-71)
(LAS-TR-199-50)

The calculation of the reflection coefficient of clouds as a function of cloud thickness, of solar, viewing, and azimuthal angles, and of scattering properties is considered. An approximate physical model was constructed that yields simple scattering relations and methods for calculating the contribution of second scattering. Explanations are given for correlating experimental results and theory. E.W.

N64-16076 Manchester U., Macclesfield (Gt. Brit.)
RESEARCH INTO METHODS OF DETERMINING THE RELATIVE HEIGHTS OF PHYSIOGRAPHIC FEATURES OF THE MOON Annual Summary Report No. 2
Zdenek Kopal Aug. 1963 20 p
(Contract AF 61(052)-524)
(ASR-2; AFCRL-64-83; AD-430705)

The research summarized in this report has been concerned with the following problems: (1) redetermination of the libration constants of the moon; (2) development of a theory of lunar librations not requiring the moon to behave like a rigid body; (3) evaluation and measurement of the old Paris photographic plates of the moon for determination of the departures of the lunar surface from a sphere; (4) determination of the exact shape of the moon from measurements of its profile during the annular eclipses of the sun on July 31st, 1962, and January 25th, 1963; and (5) an analysis of previous observations of the form of the lunar globe by expansion in tesseral harmonics with the aid of an electronic computer. Author

06 AUXILIARY SYSTEMS

Includes fuel cells and solar cells; gas turbines; hydraulic, pneumatic and electrical control systems and actuators; and inverters. *For primary propulsion systems see*: 27 Propulsion. *For related information see*: 08 Communications; 09 Electronics; 10 Facilities, Research and Support; 15 Instrumentation and Photography; and 22 Navigation and Guidance.

N64-15090 Melpar, Inc., Falls Church, Va.
BIOCHEMICAL FUEL CELL Fifth Quarterly Progress Report, 1 Jul.-30 Sep. 1963
Paul S. May, G. C. Blanchard, and R. T. Foley [1963] 54 p refs
(See N64-13968 05-16)
(Contract DA-36-039-SC-90878)
(AD-428050)

Screening studies were conducted on strains of *Clostridium welchii* and certain Pseudomonads related to metal corrosion in hydrocarbon fuel systems. These new strains produced hydrogen at rates higher than any organisms so far investigated. The gas-generating system was scaled up to 10 liters, and in this larger system *Clostridium welchii* (6785) produced H_2 at the rate of 8.2 liters/hr. The genetic work, designed to develop mutants with outstanding hydrogen generating capability, has been initiated with the development of a simple plate technique for selection of desirable mutants. The rate of hydrogen production observed on this program is expressed in terms of fuel cell consumption to make a rough preliminary appraisal of the biochemical fuel cell. Author

N64-15091 Westinghouse Electric Corp., Youngwood, Pa.
DENDRITIC SILICON SOLAR CELL PANEL [Final Report, Aug. 1962-Aug. 1963]
K. S. Tarneja and V. A. Rossi, eds. Oct. 1963 87 p
(Contract AF 33(657)-9820)
(RTD-TDR-63-4030; AD-429136)

Fabrication of high-efficiency solar cells on silicon-webbed dendrites and of solar cell panels was studied. Some of the basic design considerations and fabrication techniques are presented. Preparation of P^+N and N^+P solar cell structure is discussed. Cell efficiencies were measured using two tungsten photoflood lamps as the light source. Spectral response measurements were made on silicon web solar cells, and typical curves are presented. One mechanical sample, four operational solar cell panels, and two special operational panels were fabricated and tested. Complete results on these panels are discussed. Author

N64-15092 Westinghouse Electric Corp., Youngwood, Pa. Semiconductor Div.
DENDRITIC SOLAR CELL AND ARRAY INVESTIGATION Interim Progress Report No. 1, 1 Sep.-1 Dec. 1963
K. S. Tarneja et al [1963] 32 p
(Contract AF 33(615)-1049)
(AD-429047)

This report discusses initial work towards maximizing the radiation resistance of silicon-webbed dendrites using novel approaches, such as introduction of drift fields. Design considerations and fabrication techniques for solar cells using drift-field structures are presented. Three different approaches for achieving graded base structures are discussed. Considerations are also given to improved panel designs. Author

N64-15129 Naval Research Lab., Washington, D.C.
SEA WATER BATTERY PLUS TUNNEL DIODE CONVERTER AS A POWER SOURCE
J. M. Marzolf 22 May 1963 6 p refs
(NRL-5961; AD-406782)

To fill the need for a low-power, reliable, long-duration, maintenance-free power source for remote marine applications, the combination of a single-cell sea-water battery with a tunnel diode converter to step up the voltage is proposed. The devices should be designed for integration as a single unit for a given load and lifetime. The sacrificial anodes used in the battery can be replaced after they have been expended, but the static converter can be reused indefinitely. The compatibility of the magnesium–iron sea-water battery and tunnel diode converter has been demonstrated as a practical power source. Author

N64-15187* Gulton Industries, Inc., Metuchen, N.J. Alkaline Battery Div.
DESIGN, DEVELOPMENT AND MANUFACTURE OF STORAGE BATTERIES FOR FUTURE SATELLITES Quarterly Progress Report No. 5, 4 Nov. 1961-4 Feb. 1962
R. J. Dagnall and H. T. Staub [1962] 32 p
(NASA Contract NAS5-809)
(NASA CR-55645) OTS: $3.60 ph, $1.16 mf

Mean thermal conductivities have been determined for the VO-6 HS cell at various charge rates in a 30° F ambient. The method of determination is shown along with sample calculations. Thermal data obtained are applied to predict the behavior of other size cells of similar construction. A preliminary design for a 50 AH cell is presented along with comments on the concept of a composite terminal for large hermetically sealed cells. Author

N64-15188* Gulton Industries, Inc., Metuchen, N.J. Alkaline Battery Div.
DESIGN, DEVELOPMENT AND MANUFACTURE OF STORAGE BATTERIES FOR FUTURE SATELLITES Quarterly Progress Report No. 6, 4 Feb.–4 May 1962
R. C. Shair, G. Rampel, and K. Preusse 1962 26 p
(NASA Contract NAS5-809)
(NASA CR-55646) OTS: $2.60 ph, $0.98 mf

The pilot-plant process line has been refined and streamlined to produce reliable hermetically sealed cells with ceramic-to-metal seals. Continued work on the thermal aspects of sealed cells has resulted in a laboratory study of thermal resistances inside a cell. A mathematical analysis of heat flow in a cell shows that there is a particular set of cell dimensions that is most unfavorable from a thermal viewpoint and should be avoided in cell design. Based on thermal and mechanical considerations, the 50 AH cell has been redesigned and prototype cells are being built. Thin-plate 5AH cells have been fabricated and are being tested. These cells are in the VO-6 HS cell container, which has been reduced in height. Electrical testing will reveal if thin-plate cells show a significant advantage over the 35-mil plates now being used. Author

N64-15189* Gulton Industries, Inc., Metuchen, N.J. Alkaline Battery Div.
DESIGN, DEVELOPMENT AND MANUFACTURE OF STORAGE BATTERIES FOR FUTURE SATELLITES Quarterly Progress Report No. 7, 4 May–4 Aug. 1962
R. C. Shair, G. Rampel, and J. Liska [1962] 36 p
(NASA Contract NAS5-809)
(NASA CR-55647) OTS: $3.60 ph, $1.28 mf

Improvements in the pilot plant facility have progressed along the lines of introducing recording equipment to continuously monitor cell voltages and current, and fabricating setups to automate and simplify the handling of batches of cells as they go through electrical processing. Deep drawn containers for VO-6HS cells have been fabricated and the problems and wrinkles have been ironed out. Thin plate experimental VO-5X cells were fabricated, checked out electrically and compared to a standard VO-6HS cell. Some studies have been made on the capacity spread of VO-6HS cells and the charge efficiency of these cells is discussed. Reference electrode measurements were made to determine which electrode limits capacity. Author

N64-15190* Gulton Industries, Inc., Metuchen, N.J. Alkaline Battery Div.
DESIGN, DEVELOPMENT AND MANUFACTURE OF STORAGE BATTERIES FOR FUTURE SATELLITES Quarterly Progress Report No. 8, 4 Aug.–4 Nov. 1962
H. N. Seiger, H. Cohen, G. Rampel, J. Liska, and A. Lyall [1962] 41 p refs
(NASA Contract NAS5-809)
(NASA CR-55648) OTS: $4.60 ph, $1.43 mf

The prototype VO-50 HS cells are being completed, and 10 have been delivered. These cells have an energy capability of 18.5 watt hours per pound. VO-6 HS cells have so far been successfully cycled 1,500 cycles at 70% depth of discharge at 77° F and 1,440 cycles at 50% depth of discharge, at 77° F. Charge efficiency studies at 77° to 120° F show that early in the charge the inefficiency of the negative electrode causes evolution of hydrogen gas. This is particularly true at high charge rates and low temperatures. Studies were performed on the self-discharge (oxygen evolution) rate of positive electrodes at several temperatures and after different charge rates. Also studied was the pressure decay in cells into which oxygen had been introduced after charge at several different rates. Author

N64-15191* Gulton Industries, Inc., Metuchen, N.J. Alkaline Battery Div.
DESIGN, DEVELOPMENT AND MANUFACTURE OF STORAGE BATTERIES FOR FUTURE SATELLITES Quarterly Progress Report, 4 Nov. 1962–4 Feb. 1963
H. N. Seiger and H. Cohen [1963] 60 p
(NASA Contract NAS5-809)
(NASA CR-55644) OTS: $5.60 ph, $2.00 mf

The theories that have been propounded to explain the mechanism of the reduction of oxygen at the cadmium electrode in sealed nickel-cadmium batteries have been reviewed and critically examined. Cell efficiency studies were conducted at relatively low temperatures and charge rates, by determining (1) the charge input necessary for gas evolution, (2) the self-discharge rate of the positive electrode after charge, and (3) the recombination rate after oxygen pressurization. At low temperatures, the order of dependency of charge input required for gas initiation upon charge rate was inverted when compared with the order for the same rates at higher temperatures. The self-discharge rates doubled for a twofold increase in charge rate and for a 40° to 50° F rise in temperature. The recombination rates appeared to increase with temperature. Author

N64-15192* Gulton Industries, Inc., Metuchen, N. J. Alkaline Battery Div.
DESIGN, DEVELOPMENT AND MANUFACTURE OF STORAGE BATTERIES FOR FUTURE SATELLITES Quarterly Progress Report No. 10, 4 Feb.–4 Jun. 1963
H. N. Seiger, H. Cohen, and A. Lyall [1963] 83 p
(NASA Contract NAS5-809)
(NASA CR-55638) OTS: $8.10 ph, $2.69 mf

Cells that were placed on a 35- to 65-minute automatic cycle of a 50% depth of discharge have reached 4,634 cycles. The memory effect was observed, and overcome by two methods. The theory of oxygen reduction mechanism has been substantiated by further experiments. This theory deals with an H atom mechanism. According to a recent publication, the H atoms are interstitial in the Ni matrix. The theory is consistent with 11 experimental findings. The electrochemical theory is consistent with half of these findings. Cell efficiency studies were continued. A passivation effect was studied with controlled potential charging, and was related, descriptively, to the constant current charging. Work was also done on the charge efficiency of the positives before the onset of passivation using porous Ni bodies as the cathodes. Author

N64-15239* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
LIQUID METALS AS WORKING FLUIDS FOR POWER-GENERATION SYSTEMS TO BE USED IN SPACE
Edmond E. Bisson *In its* Advanced Bearing Technol. 1964 p 451–468 refs (See N64-15226 07-01) GPO: $1.75

This report concerns the development of power-generation systems that are suitable both as auxiliary power and as main power sources for space vehicles. Reviews and discussions are given of the power required for various missions, of the various systems necessary to produce this power, of the turbine generator system for both low- and high-power levels, and of the physical properties and corrosion of working fluids. The discussion is concerned chiefly with space power-generation systems, but some of the features discussed also apply to stationary earth-based power stations. It was concluded that the turbogenerator system is very promising for the generation of large amounts of power for space applications. The most effective cycle for such a turbogenerator system appears to be one employing a liquid metal as the working fluid in a liquid vapor cycle. C.L.W.

N64-15332 General Instrument Corp., Newark, N.J. Thermoelectric Div.
POWER FLATTENING STUDIES FOR RADIOISOTOPE-THERMOELECTRIC GENERATORS Final Report
R. E. Rush and H. Belofsky Oak Ridge, Tenn., AEC Div of Tech. Inform., 18 Feb. 1963 130 p refs
(Contract AT(30-1)-2783)
(NYO-9783) OTS: $10.50 ph, $4.16 mf

The power flattening devices considered in this report either dump excess heat outside the thermoelectric generator or use the characteristics of the generator to absorb the excess heat and thereby regulate the hot junction temperature. A number of power flattening devices have been studied both analytically and experimentally with a view toward operability in space. The most promising concepts are: (1) to utilize a secondary radiator of variable area; (2) to provide thermal shunts that are sequentially removed during the mission; (3) to use a secondary radiator coupled to the heat source through a slowly evaporating thermal connection. Author

N64-15378 General Motors Corp., Santa Barbara, Calif. GM Defense Research Labs.
STUDY OF A THERMOPHOTOVOLTAIC CONVERTER Third Quarterly Progress Report, 1 Sep.-30 Nov. 1963
Jan. 1964 74 p
(Contract DA 36-039-AMC-02255(E))
(TR64-04; AD-429822)

Work continued in this reporting period on the experimental preparation of germanium photovoltaic cells. V-I measurements were made using the 2,800° C tungsten lamp source, the tungsten lamp 1,400° C-Simulator, and the SiC laboratory test burner at temperatures of about 1,200° C. The relative energy distribution in the image plane of the 1,400° C-Simulator was determined. Theoretical studies were made on doping levels and optimum design configurations in relation to output power, temperature degradation of output power, and infrared absorption. The energy loss due to spacing gaps between cells was developed. The reflectance goniometer was completed and preliminary measurements taken. New samples have been fabricated for reflectance measurements: vacuum-deposited gold and aluminum on polished fused silica, and vacuum-deposited gold on polished germanium wafers. A calorimeter has been remetallized with improved vacuum gold-depositing techniques, and with it the gas-fired SiC mantle has been brought up to 1,395° C. Author

N64-15534* Electro-Optical Systems, Inc., Pasadena, Calif.
HYDROGEN-OXYGEN ELECTROLYTIC REGENERATIVE FUEL CELLS
Harvey Frank 18 Jan. 1964 30 p refs
(NASA Contract NAS3-2781)
(NASA CR-55650; EOS-4110-QL-2) OTS: $3.60 ph, $1.10 mf

The major accomplishments were concerned with the development of the 75-watt model and associated control apparatus to simulate orbital cycling. Development of the control and recording apparatus for continuous cycling was completed. The unit was tested and found to function satisfactorily. Voltage–current and cycle tests were carried out on simulated single cells of the final assembly. One such cell with 5.8-in.-diam. electrodes delivered 25.4 amp (148 ma/cm^2) at 0.74 v with gas pressures of 100 psig and temperature near 70° C. A smaller cell with 2 1/2-in.-diam. electrodes was carried through complete charge–discharge cycles under similar conditions. The charge voltage for the smaller cell was 1.5 v at 53 ma/cm^2, and the discharge voltage was an average of 0.8 v for the major portion of the discharge period at a current of 104 ma/cm^2. These results indicate that the design goals of the 75-watt prototype are realistic. Author

N64-15536* Electro-Optical Systems, Inc., Pasadena, Calif.
EVALUATION OF REGENERATIVE FUEL CELL Progress Report for October 1962
J. J. Rowlette 7 Nov. 1962 10 p refs
(NASA Contract NAS7-181)
(NASA Cr-55664; EOS-3310-ML-3) OTS: $1.10 ph, $0.80 mf

Considerable improvement in cell performance has been accomplished due to an improved catalyst for hydrogen electrodes and an understanding of other parameters affecting cell performance. A greater research effort was conducted on hydrogen–oxygen cells than on hydrogen–silver oxide cells. An attempt to correlate performance characteristics of silver oxide electrodes with resistivity for several doped silver oxides was initiated. In two cases, the doping process significantly reduced the oxide resistivity, but initial results of the electrode testing have not definitely shown a correlation between resistivity and electrode performance. The silver oxide electrodes are much better than all previous ones in both polarization and charging capacity. C.L.W.

N64-15549* Mallory (P. R.) and Co. Inc., Burlington, Mass. Lab. for Physical Sci.
RESEARCH AND DEVELOPMENT OF A HIGH CAPACITY NONAQUEOUS SECONDARY BATTERY Second Monthly Report, 1-31 Aug. 1963
[1963] 6 p
(NASA Contract NAS3-2780)
(NASA CR-55568) OTS: $1.10 ph, $0.80 mf

Activities are reported in two areas: (1) the anodic behavior of zinc, mercury, and silver in selected aqueous media, and (2) the synthesis of beryllium di-alkyls. R.T.K.

N64-15551* Electro-Optical Systems, Inc., Pasadena, Calif.
EVALUATION OF REGENERATIVE FUEL CELL Monthly Progress Report for Dec. 1961
Harvey A. Frank 20 Jan. 1962 4 p
(NASA Contract NAS7-7)
(NASA CR-55632; EOS-1584-M-9) OTS: $1.10 ph, $0.80 mf

Charge-retention and cycle-life tests were performed. Polarization data were obtained, as a function of temperature, with the platinized nickel electrodes as well as for several new oxygen electrodes. A study of the effect of pressure differential on cell performance established that this factor is a cause for voltage loss. Design changes were made on the multicell unit, and the fabrication was initiated. R.T.K.

N64-15562 Texas Instruments, Inc., Dallas
MOLTEN-CARBONATE FUEL BATTERY PROGRAM Technical Summary Report, 15 Feb. 1963-15 Aug. 1963
J. K. Truitt et al [1963] 88 p refs
(Contract DA-44-009-AMC-54(T))
(TI-08-63-108; AD-416422)

Power obtainable from single cells on hydrogen fuel using the 4 3/16-in. electrode diameter assembly has been increased from an average of 60 w to about 100 w/ft^2 at 0.7 v by improvements in the fuel electrode structure and reduction in electrical resistance. These cells produce approximately 60 w/ft^2 at 0.5 v on a fuel composed of 50:50 hydrogen and carbon dioxide. A laboratory model of the JP-4 air-partial-oxidation unit has produced 12.5 ft^3/hr of a gas stream containing 25- to 30-percent hydrogen, 20- to 25-percent carbon monoxide, 2- to 5-percent methane, 35- to 40-percent nitrogen, and 5- to 10-percent carbon dioxide. A series of five additives for the molten-carbonate electrolyte has been screened (Na_2MoO_4, Na_2CrO_4, Na_2WO_4, Na_2S, and Na_2ZnO_2). Only sodium sulfide was observed to have a significant positive effect on cell power output. Author

N64-15600 Aerospace Research, Inc., Boston, Mass.
PORTABLE BATTERY CHARGERS. INVESTIGATION OF LIGHTWEIGHT PORTABLE BATTERY CHARGER TECHNIQUES First Quarterly Progress Report, 15 Jun.-30 Sep. 1963
Robert B. Craven 28 Oct. 1963 105 p refs
(Contract DA-36-039-AMC-02330(E))
(ARI-167; AD-429322)

Various power conversion and control schemes are considered from the viewpoint of general applicability to the area of lightweight portable battery chargers. Several battery charging methods are described. Several possible charging current waveforms are compared from the standpoint of obtaining maximum control device utilization and optimum circuit efficiency. A detailed analysis of the a.c. conduction angle controlled charger is made, and the results of the analysis are presented in terms of the various significant circuit parameters. A novel transformerless d.c./d.c. voltage doubler circuit is described. A resonant charging circuit has been developed in which several hundred watts of power are transferred to the battery through a load winding that is magnetically coupled to an inductor in a series-resonant circuit. Author

N64-15624 General Motors Corp., Indianapolis, Ind. Allison Div.
RESEARCH AND DEVELOPMENT OF AN ADVANCED LABORATORY LIQUID METAL REGENERATIVE FUEL CELL Quarterly Technical Progress Report [No. 1], 1 Mar.-18 May 1963
H. R. Karas and J. D. Mangus 28 May 1963 106 p refs
(Contract AF 33(657)-11032)
(EDR-3344; AD-405481)

CONTENTS:
1. DEVELOPMENT AND TESTING OF ELECTROLYTE MATRIX COMBINATIONS FOR MERCURY-POTASSIUM FUEL CELL Quarterly Technical Progress Report No. 1, 12 Dec. 1962-12 Mar. 1963 H. R. Karas and J. D. Mangus 33 p refs (See N64-15625 07-09)

N64-15693 Calvin Coll., Grand Rapids, Mich.
SILVER MIGRATION AND TRANSPORT MECHANISM STUDIES IN SILVER OXIDE-ZINC BATTERIES Quarterly Technical Progress Report No. 4, 1 Feb.-1 May 1963
T. P. Dirkse and L. A. Vander Lugt 1963 20 p
(Contract AF 33(657)-8689)
(AD-404628)

A cell has been constructed by means of which it has been possible to follow the radioactivity of the electrolyte of a silver-cadmium-alkaline cell during its cycling. Several runs have been made with this cell, which was cycled under various conditions, using a radioactive silver electrode. An attempt is made to relate the appearance of silver in the electrolyte with various parts of the charge-discharge cycle. Author

N64-15694 Rocketdyne, Canoga Park, Calif.
HIGH-ENERGY BATTERY SYSTEM STUDY Quarterly Report No. 1, 1 Jul.-30 Sep. 1963
J. Farrar, R. Keller, and C. J. Mazac [1964] 31 p refs
(Contract DA-36-039-AMC-03201(E))
(R-5405-1; AD-429020)

The work accomplished consisted of purifying solvents, determining the conductance and physical characteristics of electrolytes, and making half-cell studies. In some instances the specific conductance of electrolyte solutions exceeds 2 x 10^{-2} $ohm^{-1}cm^{-1}$, but ion solvation appears to limit the attainment of high conductance values. Measured electrode potentials were steady and approximated expected values, but in the first tests appreciable polarization took place under current loads. Author

N64-15697 Thermo Electron Engineering Corp., Waltham, Mass.
ADDITIVE CONVERTER STUDIES Final Report, Nov. 1962-Nov. 1963
S. S. Kitrilakis and J. H. Weinstein Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Jan. 1964 59 p refs
(Contract AF 33(657)-10130)
(Rept. 35-64; APL-TDR-64-2; AD-429335)

Results of a program to improve the performance of thermionic converters through the use of cesium halide additives are reported. These results show that such improvement can be achieved by the reduction of collector work function at each operating condition. The reduction in work function is accomplished by a shift in the ratio of collector-to-cesium reservoir temperature ratio at which the minimum collector work function is obtained, thus allowing the converter to be operated closer to the condition of minimum collector work function than is useful in the cesium-only case. Corrosion and metallurgical examinations show no evidence of chemical attack upon converter components that can be attributed to the additives. Author

N64-15766 Eagle-Picher Co., Joplin, Mo.
RESEARCH ON AMMONIA BATTERY SYSTEM Quarterly Progress Report No. 1, 1 Jul.-30 Sep. 1963
D. J. Doan and L. R. Wood 31 Oct. 1963 27 p
(Contract DA-36-039-AMC-02173(E))
(Rept. 13; AD-429191)

A reusable multicell test fixture has been developed that increases the number of multicell tests possible per unit time. Investigation of the hot-battery failure mode has led to the disclosure of a gassing reaction at the cathode. This information was obtained through use of reference cells, which denoted the limiting plate, and through use of clear plastic cell blocks, which enabled observation of gassing action. Cause of this phenomenon has not been isolated or corrected as yet. Correction of this difficulty should result in much improved multicell performance. Author

N64-15845* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SOLAR CELL RADIATION DAMAGE STUDIES WITH 1 MEV ELECTRONS AND 4.6 MEV PROTONS
William R. Cherry and Luther W. Slifer Washington, NASA, Feb. 1964 28 p refs (See N64-11382 02-06)
(NASA TN D-2098) OTS: $0.75

The degradation of several types of solar cells irradiated with 1 Mev electrons in stages up to $10^{16}/cm^2$ was measured under standard tungsten illumination and also under air-mass-one sunlight illumination. The degradation of similar cells irradiated with 4.6 Mev protons in stages up to $3 \times 10^{11}/cm^2$ was measured under tungsten illumination. The solar cell types included p/n cells, n/p cells with various base resistivities from less than 1 ohm-cm to 25 ohm-cm, and drift field n/p cells. The results showed that the n/p cells are conclusively more resistant to either type of radiation than the p/n cells and that, within the ranges of the experiments, the n/p cells with higher base resistivity are more radiation resistant than those with lower base resistivity. Author

N64-15861* Clevite Corp., Cleveland, Ohio Electronic Research Div.

STUDY OF THIN FILM LARGE AREA PHOTOVOLTAIC SOLAR ENERGY CONVERTER Second Quarterly Report, Jan. 1-Mar. 31, 1963

Warren J. Deshotels, Frank Augustine, and Allan Carlson 15 Apr. 1963 35 p refs

(NASA Contract NAS7-203; Proj. 303160)

(NASA CR-55737) OTS: $3.60 ph, $1.25 mf

A total of 22 evaporations have been performed yielding a total of 146 film samples ranging in size from 4 × 4 in. to 1 × 1 in. Improvements in processing of samples are described, and data are tabulated to show how the average conversion efficiency has been raised from 0.5% to 2% as more parameters are identified and controlled. Spectral transmission curves are given for evaporated CdS films showing the effect on optical transmission of the barrier layer formed by the cuprous oxide slurry. Other optical measurements are discussed including the transmission and UV behavior of the plastic substrate material, the spectral energy distribution of the solar simulator, and some of the details of determining the conversion efficiency of solar cells. An exp .iment is described that shows that the barrier layer accounts for nearly all the electrical resistance in a CdS cell. Progress in "wet chemical" methods of depositing CdS films is described, as are preliminary film structure studies. Author

N64-15862* Union Carbide Corp., Parma, Ohio Development Dept.

STUDY PROGRAM TO IMPROVE FUEL CELL PERFORMANCE BY PULSING TECHNIQUES 2nd Quarterly Report, 1 Oct.-31 Dec. 1963

M. L. Kronenberg 2 Jan. 1964 20 p

(NASA Contract NAS3-2752)

(NASA CR-55742) OTS: $1.60 ph, $0.80 mf

Experiments involving mechanical pulsing of the electrolyte in the range 0 to 425 cpm were completed on carbon and on thin composite electrodes. The gaseous fuels used in these experiments were hydrogen, oxygen, and air. Polarization data were taken before, during, and after pulsing. The results indicated that in this frequency range and at pressure amplitudes ranging from 9 to 24 psia, the main effect was an accelerated "breaking-in" phenomena for the electrodes themselves rather than a significant modification in the three-phase reaction zone during pulsing. Experiments involving the mechanical motion of electrodes have been started on carbon electrodes. Electrical pulsing experiments comparing interrupted d.c. with continuous d.c. at the same average current were completed for carbon and for thin composite electrodes. A new Teflon cell was designed and is presently under construction for pulsing the electrolyte at sonic frequencies. Author

N64-15866* Clevite Corp., Cleveland, Ohio Electronic Research Div.

STUDY OF THIN FILM LARGE AREA PHOTOVOLTAIC SOLAR ENERGY CONVERTER Fourth Quarterly Report, Jul. 1-Sep. 30, 1963

Warren J. Deshotels, Frank Augustine, Allan Carlson, and J. Koenig 24 Oct. 1963 34 p refs

(NASA Contract NAS7-203; Proj. 303160)

(NASA CR-55740) OTS: $3.60 ph, $1.22 mf

The effort expended on CdS solar cells has been devoted to obtaining reproducible films and cells. Thirty evaporations were completed yielding 237 films on glass substrates and 2 films on copper-foil substrates. Improvements in the evaporation and standardization of the evaporation process resulted in "standard" films with quite uniform electrical properties. Cells processed from these films had efficiencies in the range 1.5% to 2.4%. Efficiency measurements made indoors are within 9% of those made in natural sunlight. A table is presented listing electrical properties and conversion efficiencies for a large number of photovoltaic cells. Particle size and crystallite orientation, determined from X-ray studies, are presented. The topography of the film surface at each step of cell processing has been observed with the electron microscope; electron micrographs are presented and discussed. Author

N64-15867* Clevite Corp., Cleveland, Ohio Electronic Research Div.

STUDY OF THIN FILM LARGE AREA PHOTOVOLTAIC SOLAR ENERGY CONVERTER First Quarterly Report, Oct. 1-Dec. 31, 1963

Warren J. Deshotels, Frank Augustine, and John Koenig 23 Jan. 1964 37 p refs

(NASA Contract NAS3-2795; Proj. 30320)

(NASA CR-55959) OTS: $3.60 ph, $1.31 mf

Work on CdS solar cells has been devoted to obtaining reproducible films and cells, and to fabricating CdS cells on duPont H-Film. Fifty-two evaporations were completed, yielding 217 films on glass, 50 films on duPont H-Film, 2 films on copper foil, and one attempt on a polystyrene substrate. Standard cells permit observation of a number of trends, notably the dependence of cell quality on evaporation rate and film thickness. Investigation of the problem of cell deterioration has begun, and data are presented to show that water vapor is not the only agent responsible. Experiments are described aimed at identifying these other agents. Current–voltage characteristics typical of cells fabricated in this laboratory are presented and discussed. Mathematical models of solar cells are described, and their possible extension to CdS are discussed. The "wet chemistry" approach has led to the room temperature deposition of CdS mirrors on glass; this technique is described. Author

N64-15871* Thompson Ramo Wooldridge, Inc., Cleveland, Ohio Tapco Div.

Monthly Progress Report No. 4 for October 1962 [EXPERIMENTAL PROGRAM FOR DEVELOPMENT OF AN "OSMOTIC STILL" AND IMPROVEMENT IN THE PERFORMANCE CHARACTERISTICS OF THE IONICS DUAL MEMBRANE FUEL CELL]

[14 Nov. 1962] 11 p ref

(NASA Contract NAS3-2551)

(NASA CR-55694) OTS: $1.60 ph, $0.80 mf

The current program status includes the following: (1) A total of four tests with Ionics membranes were performed. Each of these tests ended in membrane failure by cracking prior to the establishment of conditions required for membrane-performance tests. (2) A short-duration qualitative test was performed to determine if a 15-psi pressure differential across the membrane would force the liquid through a cation Ionics membrane without cracking it. No water was forced through the membrane. (3) Two single fuel-cell units have been put on life test and have been performing for over 200 hours. (4) Duplicate samples of platinized, uncoated Ti, Tri-lok mesh, epoxy, buna N, Teflon, and 9-oz glass-backed membranes were immersed in 6N H_2SO_4 in three separate baths at 30°, 60°, and 95° C. The tests were discontinued after 550 hours, and the materials were weighed and examined. (5) Techniques for coating metals and plastics with noble metals in order to protect them from hot H_2SO_4 were investigated. (6) Control equipment for four ambient-temperature (30° C) cells has been set up. (7) Large sintered electrodes have been produced. I.v.L

N64-15874 Marquardt Corp., Van Nuys, Calif.
STUDY OF BIOCHEMICAL FUEL CELLS Second Quarterly Progress Report, 1 Aug.–31 Oct. 1963
George E. Ellis and Edward E. Sweeney [1963] 47 p refs
(NASA Contract NASw-654)
(NASA CR-55739; Rept. 25105) OTS: $4.60 ph, $1.61 mf

The purpose of the investigations described in this report was to continue empirical studies on biochemical fuel cells for degrading human wastes to produce electrical energy. Investigations have been made of the electrolytic resistivities of all of the electrolytes and separators used in the biofuel cells in this laboratory. Cell constants have also been obtained for use in determining the specific resistivities of the electrolytes and separators. Measurements of the specific resistivities of a limited number of separators and of ion-exchange membranes (a total of four) were made. There was only a small difference in the specific resistivities of the materials selected, and so a particular brand of cellulose acetate has been chosen for further studies, for consistency in reporting data. Systems (flow and nonflow) have been standardized with regard to materials and construction of electrodes, separators, cathode media, structural materials, and cleaning and sterilization techniques. Author

N64-15875* Astropower, Inc., Newport Beach, Calif.
INVESTIGATION OF ZEOLITE MEMBRANES FOR FUEL CELLS Monthly Progress Report
C. Berger, F. C. Arrance, A. D. Kelmers, and M. J. Plizga [1963] 23 p refs
(NASA Contract NAS7-150)
(NASA CR-55746; Rept. 108-M3) OTS: $2.60 ph, $0.89 mf

Investigation of the application of inorganic membranes in hydrogen–oxygen fuel cells has continued. Additional zirconium oxide–phosphoric acid–"Zeolon H" compositions have been prepared, processed, and tested for modulus of rupture and electrical conductivity. A standard method for preparing inorganic membranes by either ball milling or high-speed mixing is described in detail. The addition of zirconia fibers to zirconium phosphate–"Zeolon H" membrane compositions resulted in a substantial increase in strength. Modulus-of-rupture values as high as 2,751 psi were obtained compared to 1,063 psi for the material without fibers. Increased transverse strength was also obtained through the use of more reactive grades of zirconia. A number of preliminary fuel-cell runs were made in order to improve fuel-cell design for the evaluation of membrane characteristics. Favorable preliminary results were obtained, and typical polarization curves are shown at temperatures from 80° to 120° C. Author

N64-15877* Radio Corp., of America, Princeton, N.J. David Sarnoff Research Center
THIN-FILM LARGE AREA PHOTOVOLTAIC SOLAR ENERGY CONVERTER Third Quarterly Report, 1 Apr.–30 Jun. 1963
S. G. Ellis, W. L. Hui, H. I. Moss, G. Noel, and E. F. Pasierb, Jr.
15 Jun. 1963 14 p refs
(NASA Contract NAS7-202)
(NASA CR-55741) OTS: $1.60 ph, $0.80 mf

Experiments have been done on junctions in polycrystalline GaAs to clarify the effect of intercrystalline boundaries. As the skin resistance of a cell is reduced, the leakage becomes unacceptably high. Cuprous iodide forms a photovoltaic barrier on n-type GaAs. Work has been directed at optimizing this system. A start has been made on exploring other barrier systems. GaP on GaAs structures have been made. They do not all behave like heterojunctions. Author

N64-15886* Lockheed-California Co., Burbank
STUDY FOR AN ON-BOARD ELECTRICAL POWER SYSTEM FOR A MANNED ORBITAL SPACE STATION Summary of the Final Report, 6 May–6 Nov. 1963
6 Nov. 1963 17 p
(NASA Contract NAS9-1307)
(NASA CR-55747; LR-17421) OTS: $1.60 ph, $0.80 mf

The results are presented of a study in which 10- to 40-kw electrical power systems for a large manned orbital space station were compared and evaluated. Electrical power systems, including power generation, energy storage, voltage regulation, and distribution, are considered for use in two space station configurations—the three-spoke rotating station and the cylindrical zero-g station. R.T.K.

N64-15892* Cook Electric Co., Dayton, Ohio Inland Testing Labs.
IMPROVEMENT OF NICKEL-CADMIUM BATTERIES Monthly Technical Progress Report, 20 Dec. 1963–20 Jan. 1964
[1964] 7 p
(NASA Contract NAS5-1048)
(NASA CR-55716; Rept. 33) OTS: $1.10 ph, $0.80 mf

The results of cycle-life tests on nickel-cadmium batteries at 25° C, −10° C, and 50° C are reported. R.T.K.

N64-15898* Electro-Optical Systems, Inc., Pasadena, Calif.
EVALUATION OF REGENERATIVE FUEL CELL Interim Technical Report, 25 Jun.–25 Sep. 1962
J. J. Rowlette 8 Oct. 1962 31 p refs
(NASA Contract NAS7-181)
(NASA CR-55642; EOS-3310-Q-1) OTS: $3.60 ph, $1.13 mf

A constant-current power supply cycler has been completed, and testing of both hydrogen–silver oxide and hydrogen–oxygen cells has been initiated. An experimental fuel cell has been constructed that enables individual electrode polarizations to be measured in addition to total cell polarization. It has been experimentally observed that although the main polarization for a hydrogen–oxygen cell is due to the oxygen electrode at low current densities, this polarization curve soon becomes quite flat, and at high current densities the polarization at the hydrogen electrode is current limiting. Further studies have shown that high concentrations of KOH induce greater cell polarizations at high current densities, but at low current densities high KOH concentrations result in less cell polarization. Author

N64-15899* Electro-Optical Systems, Inc., Pasadena, Calif.
EVALUATION OF REGENERATIVE FUEL CELL Monthly Progress Report, Jan. 1962
Harvey A. Frank 20 Feb. 1962 5 p
(NASA Contract NAS7-7)
(NASA CR-55639; EOS-1584-M-10) OTS: $1.10 ph, $0.80 mf

Charge retention tests were continued, and the results to date were correlated. Two cycle life tests were continued. The polarization studies included the evaluation of several radioactive, treated oxygen electrodes. Polarization studies also included the evaluation of a silver–hydrogen cell. Fabrication and assembly of the 9-cell unit was completed, and room temperature performance was measured. R.T.K.

N64-15905* Electro-Optical Systems, Inc., Pasadena, Calif.
EVALUATION OF REGENERATIVE FUEL CELL
J. J. Rowlette 8 Jan. 1963 35 p refs
(NASA Contract NAS7-181)
(NASA CR-55299; EOS-3310-Q-2) OTS: $3.60 ph, $1.25 mf

The individual effects on hydrogen and oxygen electrodes have been determined for pressure, temperature, and electrolytic purity, and the effects of mixed platinum–palladium catalysts have been determined for the hydrogen electrode. Silver oxide and 10 doped silver oxides were tested for electrical resistivity. The feasibility of hydrogen storage within a palladium electrode was demonstrated. There was no definite correlation shown between the radioactive doped silver electrodes and the pure silver control electrode. E.W.

N64-15908* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DEVELOPMENT OF A BRUSHLESS DC MOTOR FOR SATELLITE APPLICATION
Philip A. Studer Washington, NASA, Feb. 1964 14 p
(NASA TN D-2108) OTS: $0.50

Photo-optical detectors and transistorized switching duplicate the functions of the conventional commutator without physical contact. The 3-watt prototype motors have a starting torque of 2.7 oz-in. and achieve fifty percent efficiency (0.67 oz-in.) at 3,000 rpm, the speed chosen to reduce bearing and gearing problems anticipated in operation in outer space. The motor performance compares favorably with conventional d.c. motors and should significantly improve the efficiency of present systems employing a.c. motors and inverters. Author

N64-15934 Western Reserve U., Cleveland, Ohio Electrochemistry Research Lab.
KINETIC FACTORS IN FUEL CELL SYSTEMS: THE OXYGEN ELECTRODE Technical Report No. 17
Ernest Yeager and Akiya Kozawa 15 Jan. 1964 35 p refs
For presentation at the 6th AGARD Combust. and Propulsion Colloq., Cannes, France, 16–20 Mar. 1964
(Contract Nonr-2391(00); Contract Nonr-1439(09))
(AD-429248)

The results of various studies of the oxygen–peroxide couple on carbon, graphite, lithiated nickel oxide, and platinum are summarized with emphasis on the dependence of the results on electrode composition, surface preparation, pH, and electrolyte composition. Some of the implications of these fundamental studies in the optimization of oxygen cathodes for aqueous fuel cells are discussed. Author

N64-15940 Columbian Carbon Co., Princeton, N.J.
CARBON BLACK FOR ORGANIC DEPOLARIZER BATTERIES First Quarterly Progress Report, 1 Jul.-30 Sep. 1963
M. T. Johnston and J. E. Smith [Sep. 1963] 29 p refs
(Contract DA-36-039-AMC-03239(E))
(AD-430442)

This report presents the theory of the meta-dinitrobenzene-depolarized magnesium dry cell, the role of carbon black in its performance, and a review of previous work toward development of a suitable black. Also presented is a process development program including descriptions of the furnaces to be used and the variables to be studied. The various physical and chemical characterization tests to be performed on the black are discussed. Equipment and procedures for cell fabrication and testing are described. Repeatability of Columbian's cell-fabrication technique has been established. Author

N64-15961 Martin Co., Baltimore, Md. Nuclear Div.
THERMIONIC DOUBLE-DIODE PROGRAM Final Technical Report, 1 Nov. 1962-30 Nov. 1963
W. J. Levedahl et al 31 Jan. 1964 193 p refs
(Contract AF 33(657)-10077)
(MND-2945-4; RTD-TDR-63-4244; AD-429987)

Two modules, each consisting of two diodes of cylindrical configuration connected electrically in series within a single sheath and utilizing a common cesium reservoir, were fabricated and tested. The emitters were the molybdenum claddings of the UO_2–Mo cermet bushings, used to represent the nuclear fuel in the module. The two modules were tested for cumulative periods of 330 and 715 hours, respectively, at emitter temperatures between 1,500° and 2,000° C and at a spacing of 17 to 18 mils. Output power densities of 1.5 to 6 watts/cm^2 were produced under the above conditions. Eight UO_2–Mo cermet fuel pellets clad with molybdenum were fabricated for study of materials compatibility problems. Dimensional stability, thermal conductivity, electrical resistivity, UO_2 diffusion, and thermionic emission were investigated. An improved fueled thermionic double diode for out-of-pile testing adaptable to in-pile operation was designed. Author

N64-15965* Cook Electric Co., Dayton, Ohio Inland Testing Labs.
IMPROVEMENT OF NICKEL-CADMIUM BATTERIES Monthly Technical Progress Report No. 34, 20 Jan. 1964-20 Feb. [1964] 7 p
(NASA Contract NAS5-1048)
(NASA CR-53069) OTS: $1.10 ph, $0.80 mf

The objective of this study is to improve nickel–cadmium batteries through testing and analysis of failures. The results of cycle-life tests performed on a number of batteries developed by manufacturers under NASA Contracts at 25°, −10°, and 50° C are reported. R.T.K.

N64-15966* Electro-Optical Systems, Inc., Pasadena, Calif.
EVALUATION OF REGENERATIVE FUEL CELL Progress Report for Jan. 1963
J. J. Rowlette 8 Feb. 1963 9 p refs
(NASA Contract NAS7-181)
(NASA CR-53068; EOS 3310-ML-5) OTS: $1.10 ph, $0.80 mf

Progress was made on the electrolyte storage experiments. These experiments are being made to test the feasibility of electrolyte storage in the region behind the electrodes. Additional studies of the effect of KOH electrolyte concentration on cell performance have been made. Experiments have been designed, and the apparatus is now being built, for the purpose of measuring gas diffusion rates through the electrolyte–asbestos layer. Charge retention of a hydrogen–oxygen fuel cell is directly determined by these diffusion rates. Author

N64-15967* Electro-Optical Systems, Inc., Pasadena, Calif.
EVALUATION OF REGENERATIVE FUEL CELL Progress Report for November 1962
J. J. Rowlette 10 Dec. 1962 9 p
(NASA Contract NAS7-181)
(NASA CR-53067; EOS-3310-ML-4) OTS: $1.10 ph, $0.80 mf

Electrode studies have been completed, except for temperature dependence and perhaps some additional work with silver oxide electrodes. Further studies on the effect of foreign ions have substantiated earlier conclusions for the hydrogen electrode, but not for the oxygen electrode. Radioactive doped sintered silver electrodes were studied in a hydrogen–oxygen cell at room temperature and 70° C. It is concluded that they do not look promising. Hydrogen storage in a sintered palladium electrode was studied at several rather high current densities. It was found that little or no pressure buildup occurs, indicating that the hydrogen is absorbed as fast as it is formed, even at

very high charging rates. This fact, coupled with favorable discharge characteristics, indicates that the system Ag_2O–$Pd(H_2)$ may become competitive with several existing rechargeable systems. Author

N64-16008* Telecomputing Corp., Denver, Colo. Power Sources Div.
SILVER-CADMIUM BATTERY DEVELOPMENT PROGRAM Quarterly Technical Progress Report for Third Quarter, Ending 20 May 1962
John W. Rhyne 2 Aug. 1962 15 p
(NASA Contract NAS5-1431)
(NASA CR-55793) OTS: $1.60 ph, $0.80 mf

The current program status included the following: (1) Water permeability tests are being conducted on the polyamide–epoxy system, and the possibility of making a composite case, using a chemical-resistant inner material (such as styrene or epoxy) with outer layers of Saran as a moisture barrier is being investigated. (2) Three additional prototype cases have been wound and tested. (3) Two cells, G and H, were constructed using fabricated cell cases. These cases were machined from acrylic tubing and sheet; conventional terminals were used. These cells consist of 11 plates, 5 positive and 6 negative, with each plate heat sealed in an absorbent nonwoven dynel separator. Four layers of cellophane were used for the membrane separator material. The performance of these cells over the first few cycles indicates that the capacity increases even when there is an increases in the rate of discharge. I.v.L.

N64-16009* Telecomputing Corp., Denver, Colo. Power Sources Div.
SILVER-CADMIUM BATTERY DEVELOPMENT PROGRAM Quarterly Technical Progress Report for Fourth Quarter, Ending 20 Aug. 1962
John W. Rhyne 14 Sep. 1962 13 p
(NASA Contract NAS5-1431)
(NASA CR-55791) OTS: $1.60 ph, $0.80 mf

A summary of progress includes the following: (1) Moisture-permeability studies on various potential cell-case materials have been completed. The polystyrene–Saran-coated system was the most satisfactory material. (2) The material chosen for the fabrication of the cell containers was an epoxy–polyamide system consisting of 60 parts of Epon 820, 40 parts of Lancast "A," and 2 parts of DTA. Three epoxy-polyamide cell containers and covers have been made for testing and inspection. (3) Battery container number 10 is to be tested for moisture permeability and vibration. A special assembly, which was built for this purpose, has been designed to simulate the mass of the finished battery. The assembly consists of 11 loaded cell containers. (4) Two cells were constructed from cell cases molded from polystyrene. Electrical connection from the plates to the outside was provided by silver-wire leads welded to the grid plates. These cells, identified as I and J, were given initial, manual cycle tests. Cell I shorted due to a lead wire which bent during the assembly; cell J operated normally. I.v.L.

N64-16010* Telecomputing Corp., Denver, Colo. Power Sources Div.
SILVER-CADMIUM BATTERY DEVELOPMENT PROGRAM Quarterly Technical Progress Report for Fifth Quarter Ending 20 Nov. 1962
John W. Rhyne, Jr. and James M. Rice 17 Dec. 1962 48 p
(NASA Contract NAS5-1431)
(NASA CR-55790) OTS: $4.60 ph, $1.64 mf

This report includes proposed testing procedures and battery connector design. It covers container design and development, electrochemical design, and prototype fabrication and testing. C.L.W.

N64-16011* Telecomputing Corp., Denver, Colo. Power Sources Div.
SILVER-CADMIUM BATTERY DEVELOPMENT PROGRAM Final Report
James M. Rice 31 May 1963 216 p
(NASA Contract NAS5-1431)
(NASA CR-55795) OTS: $14.50 ph, $6.68 mf

The development of a lightweight, silver—cadmium secondary battery for space applications is described. The original concept for the battery incorporated the use of unit cells, with units connected in series to provide sufficient voltage, and cells connected in parallel to provide sufficient capacity. The electrodes were to be of the duplex type, and the battery case was to be filament wound, for light weight, utilizing the circular cells as a mandrel. A change in the concept was required during the program. The cells were encased in plastic cell containers, and the duplex electrode concept could not be realized. The filament-wound case was maintained. Author

N64-16012* Gulton Industries, Inc., Metuchen, N.J. Alkaline Battery Div.
DESIGN, DEVELOPMENT AND MANUFACTURE OF STORAGE BATTERIES FOR FUTURE SATELLITES First Quarterly Progress Report, 4 Nov. 1960-4 Feb. 1961
R. J. Dagnall and H. T. Staub [1961] 20 p
(NASA Contract NAS5-509)
(NASA CR-55768) OTS: $1.60 ph, $0.80 mf

Several modifications in the seal and cover design have been made so that the heat encountered in joining the cover to the can does not injure the hermetic seal. Electrode stocks embodying the desirable features of the VO-5HS and incorporating the new separator have been assembled. Individual plates have been checked on a weight basis, after electrical formation, in order to improve uniformity between cells. Details have been worked out for the cell assembly line portion of the pilot line for the fabrication of hermetically sealed cells. Author

N64-16013* Gulton Industries, Inc., Metuchen, N.J. Alkaline Battery Div.
DESIGN, DEVELOPMENT AND MANUFACTURE OF STORAGE BATTERIES FOR FUTURE SATELLITES Fourth Quarterly Progress Report, 4 Aug. 1961-4 Nov. 1961
R. J. Dagnall and H. Thomas Staub [1961] 27 p
(NASA Contract NAS5-509)
(NASA CR-55797) OTS: $2.60 ph, $1.01 mf

The use of strict quality control techniques in the pilot plant has resulted in a decrease in the number of rejections of VO-6 HS cells. The procedure for adding helium for leak detection is described. The electrical and mechanical checkout procedures to which each cell is subjected are described. The thermal and electrical characteristics of VO-6 HS cells were further studied. The use of thinner electrodes was studied to see if an improvement in watt-hour per pound output was achievable. Author

N64-16014* Atomics International, Canoga Park, Calif.
THE EFFECTS OF RADIATION ON NICKEL-CADMIUM BATTERY ELECTRODES. Final Report, 1 Jun.-31 Dec. 1963

G. R. Argue, H. L. Recht, W. A. Mc Collum, and D. E. Mc Kenzie
6 Feb. 1964 48 p refs
(JPL Contract 950514)
(NASA CR-55760; AI-64-11) OTS: $4.60 ph, $1.64 mf

The effects of various types of radiation on the electrochemical and physical characteristics of nickel and cadmium electrodes were studied. The investigation usually employed electrodes in the flooded condition. Gamma irradiation caused material loss from the electrodes and a buildup in gas pressure in sealed cells. Decreases were also observed in cell voltage and capacity. Material loss was also observed in electron irradiation. C.L.W.

N64-16015* Electric Storage Battery Co., Raleigh, N.C. Missile Battery
Final Report [DESIGN OF A STANDARD LINE OF NONMAGNETIC, SEALED, LOW RATE SILVER-OXIDE-ZINC CELLS FOR SPACE APPLICATIONS]
D. B. Colbeck 21 Mar. 1963 87 p
(NASA Contract NAS5-1607)
(NASA CR-55770; ESB E-6-63) OTS: $8.10 ph, $2.81 mf

Experimental work resolving the effects of plate thickness, sealing techniques, and various separator systems led to the design of a standard line of nonmagnetic, sealed, low-rate silver-oxide-zinc cells for space applications. Three cell sizes with nominal ratings of 20, 50, and 100 ampere-hours were constructed and tested. Objectives of 65 to 75 watt-hours per pound and 5 to 6 watt-hours per cubic inch have been met by the 20-ampere-hour cells and exceeded by the two larger sizes at discharge rates between 20 and 1,000 hours in the temperature range 10° to 50° C. Discharges at the 2,000-hour rate are in progress, with no serious degradation in performance expected. Author

N64-16032* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DERIVATION AND GENERAL CALCULATION OF CONSERVATIVE TORQUES EXERTED AT THE PADDLE-ARM AXIS OF A LABORATORY MODEL SATELLITE AND THE DETERMINATION OF THE MOMENT OF INERTIA ABOUT THE PADDLE-ARM AXIS OF A RECTANGULAR SOLAR PADDLE WITH VARIABLE PITCH
S. G. Mc Carron Sep. 1963 25 p
(NASA TM X-54604; X-636-63-197) OTS: $2.60 ph, $0.95 mf

In an effort to provide design data for the construction of an electromechanical system with the two degrees of freedom required for solar paddle orientation, the following expressions were determined: (1) the total conservative torque acting at the paddle-arm-rotation axis as a function of geometry and paddle-arm angle, and (2) the moment of inertia about the paddle-arm-rotation axis for a rectangular solar paddle as a function of geometry and pitch angle. Included are examples of the paddle-arm angles at which equilibrium and maximum conservative torques occur, data tables, and curves of the derived expressions for a specific geometry. Author

N64-16036* Telecomputing Corp., San Diego, Calif. Power Sources Div.
SILVER-CADMIUM BATTERY DEVELOPMENT PROGRAM Quarterly Technical Progress Report for Second Quarter Ending 20 Feb. 1962
John W. Rhyne 28 Mar. 1962 19 p
(NASA Contract NAS5-1431)
(NASA CR-55792) OTS: $1.60 ph, $0.80 mf

Research activities in the following areas are discussed: (1) container design—glass fiber investigation and end-plate structures; (2) ring seal to electrode bonding—evaluation of candidate ring-seal elastomeric compositions; (3) silver electrode bonding study—bonding of silver foil to itself, bonding of HNO_3 etched Ag foil to itself, bonding of Hycar 1042 to silver foil, bonding of Hycar 1042 to HNO_3 etched silver foil, study of the effect on the Ag-Hycar 1042-Ag bond upon cycling in an Ag-KOH-Ag electrolytic cell, and study of the effect on the etched Ag-Hycar 1042-etched Ag bond upon cycling in an Ag-KOH-Ag electrolytic cell; (4) methods of electrolyte addition—preparation of battery-like cells and inserting the electrolyte with a hypodermic needle, and wet assembly of a battery-like cell; and (5) electrochemical design—duplex-plate development, dry-charge plates, dry-discharge plates, electrochemical tests of three cells, separator materials, redox systems, and chelating agents. P.V.E.

N64-16060 Westinghouse Electric Co., Pittsburgh, Pa.
AN INVESTIGATION OF SOLID-ELECTROLYTE FUEL CELLS Final Report, Feb. 1962-Apr. 1963
D. H. Archer, E. F. Sverdrup, W. A. English, and W. G. Carlson Wright-Patterson AFB, Ohio. AF Aero-Propulsion Lab., Jul 1963 75 p refs
(Contract AF 33(657)-8251)
(ASD-TDR-63-448; AD-412789)

The potential value of a solid-electrolyte fuel-cell system as an electrical power supply for aerospace applications is demonstrated by the performance of actual fuel-cell batteries. Three-cell units weighing 6 g and occupying 6.2cm^3 have delivered 2.1 w, operating at electrolyte current densities of 750 ma/cm^2 and at an operating temperature of 1,000° C. This represents achieved performance of 150 w/lb and 9,500 w/ft^3 of actual battery components. The life of these batteries has not been completely evaluated. Systems studies show that self-sustaining power systems can be built weighing less than 50 lb/kw and occupying about 0.3 ft^3/kw of installed capacity in plant sizes of 0.5 kw or larger. Author

N64-16066* General Dynamics, Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science
RADIATION EFFECTS ON SILICON SOLAR CELLS Final Report, Dec. 1, 1961-Dec. 31 1962
V. A. J. van Lint, J. W. Harrity, H. Horiye, S. W. Kurnick, and D. K. Nichols et al 15 Feb. 1963 124 p refs
(NASA Contract NAS7-91; General Atomic Proj. 258)
(NASA CR-50098; GA-3872) OTS: $10.10 ph, $3.92 mf

Experiments have been performed to study the defects introduced into silicon by high energy (~ 30 Mev) electron irradiation. The diagnostic tools used include measurements of galvanomagnetic coefficients, excess carrier lifetime, electron-spin resonance, and infrared absorption. The results indicate that the A center in quartz-crucible-grown silicon is not the primary excess-carrier recombination center. Instead, recombination in quartz-crucible-grown and floating-zone refined silicon appears to be dominated by the same center. This center exhibits a strong dependence of the excess-carrier lifetime on excess-carrier density, with increasing lifetime at higher densities. The temperature dependence of the excess-carrier lifetime appears to indicate an ionization energy of approximately 0.12 ev, and this same level is seen in the galvanomagnetic measurements. Author

N64-16094 Mallory (P. R.) and Co., Inc., Indianapolis, Ind.
MERCURY CELL BATTERY INVESTIGATION Final Report, 16 Dec. 1962-15 Dec. 1963

R. E. Ralston Wright-Patterson AFB, Ohio. AF Aero-Propulsion Lab., Feb. 1964 68 p
(Contract AF 33(657)-7706)
(APL-TDR-64-15; AD-430404)

An investigation of rechargeable modifications of the electrochemical system zinc/potassium hydroxide/mercuric oxide has been conducted from the viewpoint of aerospace requirements. Preliminary design criteria have been established for a battery capable of 20-ampere discharge rates. The physical characteristics of the zinc negative electrode have been improved by the addition of an organic binder. Simultaneous evaluation of zinc electrodes without influence from positive electrodes was employed during negative electrode investigations. The applicability of a.c. impedance-type capacitance measurements to determine surface area of porous electrodes was studied. The method employed was of limited value. Mercury–palladium alloys as positive electrode materials have demonstrated rechargeability with adequate voltage regulation on discharge. X-ray diffraction and particle size distribution studies were used to determine the characteristics of the alloy material. Cells of multiple parallel electrode design were constructed and cycle tested. Author

N64-16100 Textron Electronics, Inc., Sylmar, Calif. Heliotek Div.
HIGH EFFICIENCY SILICON SOLAR CELLS Second Quarterly Progress Report, Sep. 15-Dec. 15, 1962
Paul A. Berman, Roland J. Handy, and Geza P. Rolik 15 Jan. 1963 63 p
(Contract DA-36-039-SC-90777)
(AD-402839)

Work on the effect of concentrated sunlight on the performance of solar cells under concentrated solar intensities has been continued. Cells that were diffused for twice the length of time as the standard production cells exhibited better performance under 300 mw/cm^2 solar intensity when all other parameters were identical to the standard production-type cells. The p^+/n type cells showed significantly better behavior under concentrated solar illumination than the n^+/p cells, probably due to the lower resistivity material used to fabricate the device. The actual values of diffused sheet resistance, bulk resistance, contact resistance to the diffused layer electrodes, and contact resistance to the bulk electrodes have been experimentally determined for n^+/p and p^+/n type cells. These cells have been fabricated from polycrystalline base material. Representative spectral response curves are presented. The results of environmental tests on standard production type solar cells are presented. Author

N64-16101 Westinghouse Electric Corp., Pittsburgh, Pa. Research Labs.
AN INVESTIGATION OF SOLID ELECTROLYTE FUEL CELLS Second Quarterly Technical Progress Report
D. H. Archer, W. G. Carlson, W. A. English, D. Hart, L. Kroko et al [1962] 94 p refs
(Contract AF 33(657)-8251)
(AD-283434)

An electrolyte material with a resistivity less than one-fifth that of $(ZrO_2)_{0.85}(CaO)_{0.15}$ was discovered. Various methods for applying electrodes to the electrolyte have been tried; standard procedures have been worked out for evaluating these electrodes. Three methods of sealing cells have been investigated so that large systems can be fabricated. A number of cell tests have been carried out to determine the performance of electrolytes, electrodes, and seals. Author

N64-16103* Naval Ammunition Depot, Crane, Ind. Quality Evaluation Lab.
EVALUATION PROGRAM FOR NICKEL CADMIUM SEALED CELLS: ACCEPTANCE TEST OF GULTON INDUSTRIES 20.0 AMPERE HOUR CELLS
E. C. Bruess 14 Jun. 1963 17 p
(NASA Purchase Order W11252B)
(NASA CR-55627; QE/C 63-317) OTS: $1.60 ph, $0.80 mf

Evaluation of sealed nickel cadmium cells was begun. From the results of the acceptance tests of 100 20-amp-hr-size cells (rated at 20.0 amp hr), it was concluded that: (1) the rated discharge capacity of the cells is repeatable when given special handling procedures; and (2) the capacity of the cells was in the acceptable range of 20.1 to 26.8 amp hr. R.T.K.

N64-16104* Naval Ammunition Depot, Crane, Ind. Quality Evaluation Lab.
EVALUATION PROGRAM FOR NICKEL CADMIUM SEALED CELLS: GENERAL PERFORMANCE TEST OF GENERAL ELECTRIC COMPANY 3.0 AMPERE HOUR CELLS
E. C. Bruess 6 Jan. 1964 40 p
(NASA Purchase Order W11252B)
(NASA CR-55630; QE/C 64-1) OTS: $3.60 ph, $1.40 mf

The cells were capable of withstanding the vibration, mechanical shock, and acceleration requirements. Temperatures below and above 25° C imposed the primary limitations on the charge acceptance and the discharge capacity of the cells. At 25° C, the on-charge voltage did not reach the maximum limit of 1.50 volts/cell at the c/10 charge rate but did reach the limit on a few occasions at the c/5 charge rate at 90 percent of the charging period. At 0° C, the on-charge voltage reached the maximum limit of 1.50 volts/cell at about 75 percent of the charging period at both the c/10 and c/5 rates. At 50° C, the on-charge voltage never reached the maximum limit of 1.50 volts/cell. The cells, at 0° C, were incapable of accepting a continuous overcharge at a rate of c/10 or higher, as the maximum on-charge voltage limit of 1.55 volts/cell was reached prematurely. Charging efficiency was limited by temperature. At 0° C, the voltage limit of 1.50 volts/cell was reached at each charge rate at approximately 100 percent of the charge period (c/10 for 10 hours), thereby limiting the charge acceptance and discharge capacity. At 25° C, the voltage limit was reached only at the c/1 charge rate. At 50° C, the voltage limit was not reached at any of the charge rates. Author

N64-16105* Naval Ammunition Depot, Crane, Ind. Quality Evaluation Lab.
EVALUATION PROGRAM FOR NICKEL CADMIUM SEALED CELLS: GENERAL PERFORMANCE TEST OF GOULD-NATIONAL BATTERIES, INC. 3.5 AMPERE HOUR "D" CELLS
E. C. Bruess 26 Jan. 1964 40 p
(NASA Purchase Order W11252B)
(NASA CR-55631; QE/C 64-7) OTS: $3.60 ph, $1.40 mf

The cells were capable of withstanding the vibration, mechanical shock, and acceleration requirements. Temperature below and above 25° C imposed the primary limitations on the charge acceptance and the discharge capacity of the cells. At 25° C, the on-charge voltage reached the maximum limit of 1.50 volts/cell at about 75 percent of the charging period at both the c/10 and c/5 rates. At 0° C, the on-charge voltage reached the maximum limit of 1.50 volts/cell at about 50 percent of the charging period at both the c/10 and c/5 rates. At 50° C, the on-charge voltage never reached the maximum limit of 1.50 volts/cell. The cells, at 0° C, were incapable of accepting a continuous overcharge at a rate of c/10 or higher, as the maximum on-charge voltage limit of 1.55 volts/cell was reached prematurely. Charging efficiency was limited by temperature. At 0° C, the voltage limit of 1.50 volts/cell was reached

at each charge rate before the cells reached 100-percent charge, thereby limiting the charge acceptance and the discharge capacity. At 25° C, the voltage limit was reached only at the c/1 rate. At 50° C, the voltage limit was reached on only one of the two cells at the c/1 charge rate. Author

N64-16113* De Havilland Aircraft Co., Ltd., Downsview (Canada)
AN EXTENDIBLE BOOM SYSTEM FOR SPACE VEHICLES
R. L. Samuels and P. A. Lapp 30 Jan. 1963 50 p
(NASA Contract NAS5-2390)
(NASA CR-55578; DHC-SP-R48) OTS: $4.60 ph, $1.70 mf

The report describes a suitable means by which a magnetometer or similar instrument may be protruded from a carrier-vehicle in spaceflight. The proposed system resulted from a design study of an existing principle—a storage drum and guidance device that pays out a heat-treated metal strip, which then assumes tubular configuration. Tape-type conduits are shown to be the most satisfactory form of internally located cable pack. A novel technique is adopted to provide the electrical link between the stationary and moving components. Very low power output is required to drive the mechanism. Author

07 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy); chemical engineering; chemical properties of materials; and synthesis. *For related information see*: 18 Materials, Metallic; 19 Materials, Nonmetallic; and 26 Propellants and Combustion.

N64-15071 National Carbon Co., Parma, Ohio
RESEARCH AND DEVELOPMENT ON ADVANCED GRAPHITE MATERIALS. VOLUME XXVIII: POLAROGRAPHIC REDUCTION OF POLYNUCLEAR AROMATICS
I. C. Lewis, H. Leibecki, and S. L. Bushong Wright-Patterson AFB, Ohio, AF Materials Lab., Nov. 1963 19 p refs
(Contract AF 33(616)-6915)
(WADD-TR-61-72, Vol. 28; AD-426666)

Polarographic reduction potentials (E 1/2) have been measured for polynuclear aromatic hydrocarbons. The E 1/2 parameters for structurally similar hydrocarbons have been related to the positions of the respective long-wavelength "p" bands. Polarographic reduction potentials have also been determined for a series of substituted pyrenes and anthracenes. E 1/2 is shown to relate to the electronic effect of the substituent group. The application of polarography to the characterization of aromatics in complex pyrolytic residues is discussed. Author

N64-15081 Aerospace Corp., El Segundo, Calif. Labs. Div.
MATERIALS AND STRUCTURES, HIGH-TEMPERATURE CHEMISTRY Semiannual Technical Report, 1 Jan.-30 Jun. 1963
J. E. Colwell, T. J. Dudek, T. S. Lee, F. M. Wachi, and M. T. O'Shaughnessy 20 Nov. 1963 17 p refs
(Contract AF 04(695)-169)
(SSD-TDR-63-321; TDR-169(3240-22)TR-1; AD-427230)

Studies of combustion of Teflon monomer (C_2F_4) and studies of mechanical and electrical properties of polymers are described. In the Teflon flame studies, CF_2 has been detected spectroscopically in both diffusion and premixed flames; CF was detected, with less certainty, in diffusion flames. Apparatus has been constructed for detecting ionization and for following electron decay using an RF energy absorption method. In the polymer investigations, styrene-butadiene and ethylene-propylene rubbers of graded cross-link density have been studied mechanically in tension. A swelling–deswelling technique, applied at fixed length, has been used to design "equilibrium" stress-strain curves. A pulse method has been devised for the very rapid measurement of dielectric constant and loss, and is being evaluated. Author

N64-15111 Naval Radiological Defense Lab., San Francisco, Calif.
APPLICATIONS OF RADIOCHEMISTRY TO SOLUTION OF RADIOLOGICAL PROBLEMS
N. E. Ballou In ONR Solution to Navy Probl. through Advanced Technol. [1963] p 149-157 refs (See N64-15101 07-01) OTS: $5.00

The application of radiochemistry to the definition of properties of nuclear-weapons' debris is described. Properties selected as being important in radiological effects include dose rates, radionuclide composition (fission product and neutron-induced radionuclides), fractionation, and physical and chemical states (solubilities and oxidation states). In addition, the radiochemical method for the determination of the fission-weapon's yield is outlined. R.T.K.

N64-15122 United States Rubber Co., Wayne, N.J. Research Center
PHOSPHONITRILIC POLYMERS STABLE AT HIGH TEMPERATURES Final Report, 19 Nov. 1962-18 Nov. 1963
Harold K. Garner and Gerald J. Klender 7 Jan. 1964 60 p refs
(Contract NObs 88232)
(AD-428598)

The objective of this investigation was the development of new thermoplastic and thermosetting resins from phosphonitrilic chloride trimer for high-temperature electrical applications. Derivatives of phosphonitrilic chloride trimer have been prepared with a portion of the chlorines replaced by thermally stable phenyl or phenoxy blocking groups, and the remaining positions occupied by reactive chloro, ethoxy, or dimethylamino groups. The derivatives or mixtures of derivatives containing phenoxy, ethoxy, and chloro groups in various proportions have been thermally polymerized with the elimination of ethyl chloride to give hard, clear, light-colored resins. Author

N64-15180 Phillips Petroleum Co., Idaho Falls, Idaho
REMOVAL OF RADIOISOTOPES FROM SOLUTION BY EARTH MATERIALS FROM EASTERN IDAHO
M. W. Wilding and D. W. Rhodes AEC National Reactor Testing Station, 8 Nov. 1963 66 p refs
(Contract AT(10-1)-205)
(IDO-14624) OTS: $1.50

It was concluded that material containing a high content of clinoptilolite was the most promising candidate because of (1) excellent physical and chemical stability, (2) a cation exchange capacity of about 0.3 milliequivalent per gram, (3) ability to remove radioisotopes from solution over a wide pH range, and (4) the ready availability of thousands of tons of the raw material. The distribution coefficients of this material for cesium and strontium were determined to be greater than 1,000 at favorable pH values. A brief study of the effect of complexing agents on the reaction of radioisotopes with

the earth materials indicated that citrate depressed the adsorption of ruthenium markedly and that EDTA depressed the adsorption of strontium, cobalt, and ruthenium more than the adsorption of cerium and chromium. Author

N64-15221* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
CHEMICAL RELAXATION BEHIND STRONG SHOCK WAVES IN CARBON DIOXIDE INCLUDING INTERDEPENDENT DISSOCIATION AND IONIZATION PROCESS
John T. Howe and Yvonne S. Sheaffer Washington, NASA, Feb. 1964 54 p refs
(NASA TN D-2131) OTS: $1.50

Collision theory is used to estimate chemical reaction rate coefficients for the dissociation of CO_2 and CO and for the ionization of CO, O, and C. The estimated coefficients are used to obtain solutions for the interdependent dissociation and ionization processes of CO_2 and its components (including eight chemical species) coupled with the fluid flow behind a normal shock wave. Solutions of both the nonequilibrium chemical relaxation region behind the shock wave and the asymptotic equilibrium conditions are obtained for shock speeds ranging from 9 to 20 km/sec and ambient densities of 10^{-2} to 10^{-4} standard earth atmosphere density. Results are presented in the form of flow-field profiles of pressure, temperature, density, enthalpy, velocity, species concentration, and relaxation distance behind the shock. In addition, tables and graphs of asymptotic equilibrium properties and composition are presented. The effects of the state of internal excitation on the chemically relaxing flow field are investigated. Author

N64-15243 California U., Berkeley Lawrence Radiation Lab.
A SOLVENT EXTRACTION STUDY OF PROTON SOLVATION
Teresa Jean Conocchioli (M.S. Thesis) 4 Sep. 1963 79 p refs
(Contract W-7405-eng-48)
(UCRL-10971) OTS: $2.00

The extraction of $HClO_4$ and HNO_3 into dilute solutions of tri-n-octyl phosphine oxide (TOPO) in carbon tetrachloride and nitrobenzene is studied, and the nature of the extracting species is determined. In the extraction of dilute $HClO_4$ ($\leq$0.2M) into dilute TOPO ($\leq$0.1M) in CCl_4, the extracting species are $TOPO{\cdot}H_2O$ and $H_3O^+{\cdot}3\ TOPO...ClO_4^-$. The predominant species in the extraction of HNO_3 ($\leq$0.3M) is anhydrous $TOPO \cdot HNO_3$. In the extraction of both dilute $HClO_4$ and HNO_3 into TOPO in nitrobenzene, the extracting species is $H_3O^+{\cdot}3\ TOPO{\cdot}yH_2O + X^-$, in which y is probably 0 but may be as large as 3, and in which X^- is the anion. The results of the extraction are interpreted on the basis of the evaluation of the relative basicities of all components in each system and of the dielectric constant of the inert diluent. Author

N64-15271 Gt. Brit. Ministry of Aviation, Mottingham Technical Information and Library Services
THE MANUFACTURE AND PROPERTIES OF COBALT (III) ACETATE
M. Nana, H. Yeshiyuki, and S. Muraji Jan. 1964 6 p refs
Transl. into ENGLISH from Nippon Kagaku Zasshi (Tokyo), v. 77 (9), 1956 p 1434–1437
(TIL/T 5412)

The manufacture, structure, and decomposition reactions of cobalt (III) acetate in aqueous solution are reported. Author

N64-15337 Iowa State U. of Science and Tech., Ames
EXTRACTION OF URANIUM, THORIUM, HAFNIUM AND THE ALKALINE EARTH ELEMENTS WITH BIS(DI-*n*-HEXYLPHOSPHINYL)METHANE FROM PERCHLORIC ACID SOLUTIONS. SIMULTANEOUS SPECTROPHOTOMETRIC DETERMINATION OF TRACE AMOUNTS OF CALCIUM AND MAGNESIUM WITH CHLOROPHOSPHONAZO III
Jerry Walter Ferguson and Charles Banks Nov. 1963 43 p refs
(Contract W-7405-eng-82)
(USAEC Res. and Develop. Rept. IS-777) OTS: $1.00

The extraction of hafnium, thorium, uranium, magnesium, calcium, barium, and strontium with HDPM in 1,2-dichlorobenzene from perchloric acid solutions in a three-to-one molar ratio of HDPM to metal ion was studied. Most of the hafnium formed a precipitate between the phases. Thorium was nearly quantitatively extracted from all concentrations of perchloric acid. Uranium was quantitatively extracted from all concentrations of perchloric acid. The alkaline earth elements were not well extracted from any concentration of perchloric acid. A rapid and sensitive spectrophotometric procedure for determining calcium and magnesium with Chlorophosphonazo III is described. Either calcium or magnesium may be determined at pH 7.0 in the range of 0.1 μg per 25 ml (0.004 ppm) to 10 μg per 25 ml (0.4 ppm). In mixtures of calcium and magnesium, calcium is determined at pH 2.2 at a wavelength of 667.5 mμ. The magnesium is then determined by difference at pH 7.0 and 669 mμ where the absorbances of the two metal complexes are additive. Author

N64-15339 Oak Ridge National Lab., Tenn. Analytical Chemistry Div.
ANALYTICAL CHEMISTRY DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING NOVEMBER 15, 1963
M. T. Kelley and C. D. Susano 18 Feb. 1964 162 p refs
(Contract W-7405-eng-26)
(ORNL-3537) OTS: $2.75

Research activities in the following areas are summarized: (1) analytical research—analytical instrumentation, chemical analysis of advanced reactor fuels, analytical studies of molten-salt systems, reactor projects, effects of radiation on analytical methods, X-ray and spectrochemical analysis, mass spectrometry, infrared spectroscopy, optical and electron microscopy, nuclear and radiochemical analyses, and inorganic and organic preparations; (2) methods development; (3) service analyses—quality control, low-level radiochemical laboratory, mass spectrometric analysis, spectrochemical analyses laboratory, process analyses, and reactor-engineering service laboratory. P.V.E.

N64-15492 Northeastern U., Boston, Mass.
PHOTOCHEMICAL STUDIES OF SOME ORGANIC SULFUR COMPOUNDS AND KETONES
K. Weiss, H. Köller, D. H. Lambert, G. P. Rabold, W. M. Moreau et al *In its* Res. in Energy Conversion 22 Nov. 1963 p 110-259 refs (See N64-15489 07-01)

The topics discussed include: (1) photochemical reactions of organic sulfur compounds—fluorescence quenching by disulfides, charge-transfer interactions of disulfides, photochemical apparatus, analytical techniques, and irradiation experiments; (2) the photochemistry of perinaphthenone and some related ketones—observations, trapping experiments, isolation experiments, irradiation experiments in solvents, kinetic experiments, evaluation of results with perinaphthenone, experiments with other ketones, and kinetic experiments, and (3) flash photolysis. R.T.K.

N64-15495 Air Force Cambridge Research Labs., Bedford, Mass.

ION DISSOCIATION IN THE DRIFT TUBE OF A TIME-OF-FLIGHT MASS SPECTROMETER: IV. SPURIOUS FRAGMENT PEAKS ORIGINATING FROM NORMAL IONS HEAVIER THAN THE DISSOCIATING PARENT ION

W. W. Hunt, Jr. and M. J. Kennedy Dec. 1963 9 p refs
(AFCRL-63-926; AD-429438)

The drift tube of a time-of-flight mass spectrometer can be used as the reaction chamber for kinetic studies of ion dissociation reactions. When the instrument is used in this way, interpretation of the results can be seriously affected by spurious fragment peaks that do not represent products of the ion dissociation reaction being studied. When the fixed Δt method of identifying dissociation products is used, spurious fragment peaks originating from normal ions whose unretarded flight times lie between the unretarded and shifted flight times of the parent ion are particularly troublesome. The ions responsible for such peaks can, however, be identified by means of the flight-time-shift equations, which can also be used to predict the retarder voltage V_{rf} at which a particular ion will appear as a spurious fragment peak. Author

N64-15564 Atomic Energy Commission, New Brunswick, N.J.

INVESTIGATION OF THERMIONIC EMISSION ION SOURCES FOR THE ISOTOPIC ANALYSIS OF LITHIUM

H. O. Finley and J. J. Pucilowski, Jr. Dec. 1963 15 p refs
(NBL-205) OTS: $0.50

A mass-spectrometric procedure using a triple filament, thermal-emission ion source for the analysis of lithium has been developed. Five portions of an isotope reference sample No. 9 (NBS) of lithium carbonate were converted to the nitrate form and analyzed using two types of ion sources and two sample holders. It has been found that a triple filament ion source with a 0.005-in.-diameter tungsten wire as an ionizing filament and a 0.060-in.-wide, 11/16-in.-long, and 0.008-in.-thick Nichrome sample holder is the most desirable. A steady ion current is achieved in about 15 minutes. The precision of the measured atom % Li^6 is 0.018 (Standard Deviation). The standard deviation between charges is 0.05. Author

N64-15565 Weapons Research Establishment (Australia)

A GAS CHROMATOGRAPH FOR TRACE ANALYSIS OF HYDROCARBONS

S. W. Hiscock and I. M. Napier Oct. 1963 34 p refs
(WRE-TN-CPD-73)

A gas chromatograph is described capable of separating and determining the C_1 to C_6 hydrocarbons present in oxygen or nitrogen in concentrations as low as one part per million. It is possible to determine acetylene at a concentration of 0.05 parts per million. Author

N64-15604 United Kingdom Atomic Energy Authority, Harwell (Gt. Brit.)

A METHOD FOR THE DECOMPOSITION OF AMMONIUM NITRATE IN AQUEOUS SOLUTION

R. L. Faircloth Jul. 1963 28 p refs
(AERE-R-4393) HMSO: 35

A method is suggested for the decomposition of ammonium nitrate contained in effluent liquors. This involves the electrochemical reduction of the nitrate to ammonium nitrite with subsequent decomposition, by heating, to nitrogen and water. The feasibility of the method was studied by means of a number of electrochemical experiments designed to test various electrode systems, and a series of chemical experiments, in which the rate constant for the decomposition of ammonium nitrite was determined, were also carried out. Various theoretical aspects of the system are discussed. Author

N64-15648 Joint Publications Research Service, Washington, D.C.

PRINCIPLES OF THE CHEMICAL TECHNOLOGY OF ARTIFICIAL RADIOACTIVE ELEMENTS

Ya. I. Zil'berman 24 Feb. 1964 479 p refs Transl. into ENGLISH of a book "Osnovy Khimicheskoy Tekhnologii Iskustvennykh Radioaktivnykh Elementov" Moscow, State Publ. House for Atomic Sci. and Technol. Lit., 1961 p 1-332
(JPRS-23350; OTS-64-21627) OTS: $6.00

The topics discussed are: (1) the obtaining of nuclear fuel from reactors; (2) the preparation of irradiated material for chemical processing; (3) the theoretical basis of isolating a microcomponent on a carrier; (4) the chemistry and technology of isolating plutonium and uranium-233 by carrier precipitation methods; (5) flowsheets for the separation and purification of uranium and plutonium by the methods of carrier codeposition; (6) the role of radio colloids in the technology of nuclear fuel; (7) the theoretical bases of extraction by organic solvents; (8) extraction processes; (9) the behavior of elements during extraction; (10) separation of radioactive elements by ion exchange; (11) electrochemical methods of separation; (12) radiochemical plants and laboratories; (13) the processing of industrial wastes; (14) the chemical effects of radiation; (15) the biological effects of the radiation maximum-permissible dose; and (16) the basis of the design of a γ-ray shield. R.T.K.

N64-15651 Atomic Energy Commission, Washington, D.C. Div. of Technical Information

PROCEEDINGS OF THE PROTACTINIUM CHEMISTRY SYMPOSIUM, GATLINBURG, TENNESSEE, APRIL 25-26, 1963

Feb. 1964 174 p refs
(TID-7675) OTS: $2.75

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N64-15652 United Kingdom Atomic Energy Authority, Harwell (Gt. Brit.)

PROTACTINIUM SPECIES IN TBP-NITRIC ACID SYSTEMS

Clarence J. Hardy and D. Scargill *In* AEC, Washington Proc. of the Protactinium Chem. Symp., Gatlinburg, Tenn., Apr. 25–26, 1963 Feb. 1964 p 1–15 (See N64-15651 07-07) OTS: $2.75

The species of protactinium in nitric acid and TBP (tri N-butyl phosphate) was investigated by the following: (1) extraction of aqueous solutions with 30% to 50% TBP in kerosene or xylene as a function of the concentrations of protactinium (10^{-3} to 10^{-6}M), of nitric acid (1 to 10 M), of the ratio of the volumes of the solvent and aqueous phases, and of the temperature; and (2) paper chromatography of TBP phases with methylisobutylketone and solutions of TBP in kerosene as eluting solvents. In particular the following are discussed: (1) behavior of protactinium in aqueous nitric acid—the variation of D_{Pa} with aging time after decreasing the Pa concentration in 6M HNO_3, the variation of D_{Pa} after decreasing the Pa concentration in 10M HNO_3, the variation of D_{Pa} with aging time after decreasing the Pa concentration at various acid concentrations from 1 to 9M HNO_3; and (2) behavior of protactinium in TBP phases—extraction of protactinium at various ratios of the volumes of the organic and aqueous phases, paper chromatography of Pa in TBP phases (elution with methylisobutylketone and elution with TBP in kerosene). P.V.E.

N64-15653 Oak Ridge National Lab., Tenn.

SEPARATION OF PROTACTINIUM FROM THORIUM IN NITRIC ACID SOLUTIONS BY SOLVENT EXTRACTION WITH TRIBUTYL PHOSPHATE OR BY ADSORPTION ON PULVERIZED UNFIRED VYCOR GLASS OR SILICA GEL

J. G. Moore and Robert H. Rainey *In* AEC, Washington Proc. of the Protactinium Chem. Symp., Gatlinburg, Tenn., Apr. 25–26, 1963 Feb. 1964 p 16–34 refs (See N64-15651 07-07) OTS: $2.75

Two methods are being investigated for the separation and recovery of protactinium from short-decayed thorium reactor fuels after dissolution in nitric acid solutions. The protactinium may be preferentially adsorbed on pulverized unfired Vycor glass or silica gel, or the protactinium, thorium, and uranium may be coextracted with tributyl phosphate. Major effort has been on the adsorption method, using unfired Vycor glass. Author

N64-15654 Oak Ridge National Lab., Tenn.

PROTACTINIUM STABILITY IN THORIUM NITRATE-NITRIC ACID SOLUTIONS

C. J. Barton, David R. Cuneo, M. J. Kelly, and J. E. Strain *In* AEC, Washington Proc. of the Protactinium Chem. Symp., Gatlinburg, Tenn., Apr. 25–26, 1963 Feb. 1964 p 35–45 refs (See N64-15651 07-07) OTS: $2.75

Protactinium, in the concentration range 10 to 100 ppm, appears to be sufficiently stable in solutions containing up to 2.5M $Th(NO_3)_4$ and as little as 0.2M free nitric acid at a temperature of 180° C or less to encourage further consideration of solutions of this type for use as a breeder blanket in two-region aqueous homogeneous reactors. Further experimentation would be required to accurately define permissible operating concentrations and temperatures. Author

N64-15655 Oak Ridge National Lab., Tenn.

REMOVAL OF PROTACTINIUM AND URANIUM FROM THORIUM NITRATE-NITRIC ACID SOLUTIONS

G. L. Johnson, D. R. Cuneo, H. F. Mc Duffie, and M. J. Kelly *In* AEC, Washington Proc. of the Protactinium Chem. Symp., Gatlinburg, Tenn., Apr. 25–26, 1963 Feb. 1964 p 46–56 refs (See N64-15651 07-07) OTS: $2.75

Peroxide precipitation was tested as a possible technique for side-stream processing to remove Pa. For various concentrations of thorium, the threshold peroxide concentration (below which Pa returned to solution) varied with the concentration of added acid. The higher the acidity, the higher the peroxide threshold level for Pa return. Generally the more peroxide added initially, the more thorium was precipitated. The threshold level for Pa return did not seem to be affected by the initial peroxide concentration at any one level of acid. Peroxide was found to decompose in thorium nitrate–nitric acid solutions in what appears to be a process that is of first order in peroxide concentration (as dose uranium). The activation energy calculated from the data was 22 kcal. The rate of decomposition in thorium solutions was increased by increasing the acidity. In every case in which sufficient peroxide was present to cause precipitation of some of the thorium, and when the particulate material reached a size that could be satisfactorily centrifuged from the solution, the Pa was removed with the precipitate. P.V.E.

N64-15656 Argonne National Lab., Ill.

PROTACTINIUM FLUORIDES

Lawrence Stein *In* AEC, Washington Proc. of the Protactinium Chem. Symp., Gatlinburg, Tenn., Apr. 25–26, 1963 Feb. 1964 p 57–71 refs (See N64-15651 07-07) OTS: $2.75

Reactions have been studied with 5 to 200 mg amounts of Pa^{231}; most products have been identified by X-ray powder patterns and chemical or radiochemical analyses. Protactinium tetrafluoride is obtained as dark brown, monoclinic, needlelike crystals on heating Pa_2O_5 in a mixture of HF and H_2. When the tetrafluoride is heated with purified fluorine, it is converted to the pentafluoride, which is a white solid isomorphous with the β form of UF_5 (tetragonal crystal structure). When protactinium tetrafluoride is heated with fluorine containing oxygen impurity, an oxyfluoride is obtained that appears to have the composition Pa_2OF_8. When protactinium pentoxide is dissolved in aqueous hydrofluoric acid, and the solution is evaporated to dryness at 110°, colorless needlelike crystals of the approximate composition $PaF_5 \cdot 2H_2O$ are obtained. Author

N64-15657 Oak Ridge National Lab., Tenn.

CHARACTERIZATION OF PROTACTINIUM SPECIES IN CRYSTALS AND SOLUTIONS BY RAMAN AND INFRARED SPECTROSCOPY

O. L. Keller, Jr. *In* AEC, Washington Proc. of the Protactinium Chem. Symp., Gatlinburg, Tenn., Apr. 25–26, 1963 Feb. 1964 p 72–85 refs (See N64-15651 07-07) OTS: $2.75

A method of using Raman and infrared spectroscopy in determining the Pa species in the specific system Pa-hydrofluoric acid is outlined. P.V.E.

N64-15658 Oak Ridge National Lab., Tenn.
RECOVERY OF URANIUM AND PROTACTINIUM FROM MOLTEN FLUORIDE SYSTEMS BY PRECIPITATION AS OXIDES

J. H. Shaffer, G. M. Watson, D. R. Cuneo, J. E. Strain, and M. J. Kelly *In* AEC, Washington Proc. of the Protactinium Chem. Symp., Gatlinburg, Tenn., Apr. 25–26, 1963 Feb. 1964 p 86 Abstract only Submitted for Publication (See N64-15651 07-07) OTS: $2.75

Fissionable U^{233} will be recovered from the blanket as the decay product of Pa^{233} in the conceptual two-region molten-salt breeder reactor. Equilibrium concentrations of Pa^{233} in the blanket mixture would result in appreciable parasitic neutron absorptions because of half-life and neutron-absorption cross-section values. A method of precipitating uranium and protactinium as oxides from solution in a molten fluoride solvent was examined to demonstrate the possibility of exploiting the thermal-breeding potential of a molten-salt breeder reactor. Protactinium, present initially either in concentrations of about 1 ppb or 50 ppm, was removed from molten mixtures of $LiF-BeF_2-ThF_4$ (67–18–15 mole %) by the addition of 1 to 2 wt % solid beryllium or thorium oxides, apparently by precipitation of protactinium on the surface of the added oxide. The effective removal of approximately 2,000 ppm uranium from solution in the same solvent was also accomplished by the addition of 3 wt % beryllium oxide or by the use of comparable amounts of ThO_2 as the solid oxide precipitant. Author

N64-15659 Oak Ridge National Lab., Tenn.
THE CHEMISTRY OF PROTACTINIUM IN SULFURIC ACID SOLUTIONS

David O. Campbell *In* AEC, Washington Proc. of the Protactinium Chem. Symp., Gatlinburg, Tenn., Apr. 25–26, 1963 Feb. 1964 p 87–104 refs (See N64-15651 07-07) OTS: $2.75

Solubility, amine extraction, and ion exchange experiments involving sulfate and sulfuric acid solutions of protactinium are discussed. Particular areas of research discussed are: (1) variation of extraction coefficient with H_2SO_4 concentration; (2) protactinium extraction by secondary amines; (3) dependence of distribution coefficient on concentration of sulfate in organic phase; (4) protactinium extraction with Dowex 1 resin; (5) aqueous protactinium concentration in equilibrium with Dowex 1 resin; (6) effect of protactinium concentration on extraction into Dowex 1 resin; and (7) effect of acid and protactinium concentration on extraction into Dowex 1. P.V.E.

N64-15660 Johannes Gutenberg-Universität, Mainz (W. Germany) Inst. für Anorganische Chemie und Kernchemie
IONIC SPECIES OF PROTACTINIUM IN HYDROCHLORIC ACID

Hans-Ludwig Scherff and Günter Herrmann *In* AEC, Washington Proc. of the Protactinium Chem. Symp., Gatlinburg, Tenn., Apr. 25–26, 1963 Feb. 1964 p 105–121 refs (See N64-15651 07-07) OTS: $2.75

The solvent extraction of protactinium from hydrochloric acid by diisobutylcarbinol "DIBC," $(i\text{-but})_2CH\text{-}OH$, was investigated, and an attempt was made to evaluate protactinium species from the partition data. Weighable amounts of Pa^{231} were procured; part of this material was a concentrate in zirconium phosphate, containing about 10% of Pa^{231}. DIBC allows a very simple Pa–Zr separation. At 6 *N* HCl the Pa–Zr separation factor is about 10^7. Author

N64-15661 Mound Lab., Miamisburg, Ohio
HYDROLYSIS AND RESIDUE ADSORPTION OF PROTACTINIUM

Harold W. Kirby *In* AEC, Washington Proc. of the Protactinium Chem. Symp., Gatlinburg, Tenn., Apr. 25–26, 1963 Feb. 1964 p 122–156 (See N64-15651 07-07) OTS: $2.75

A residue adsorption technique applied to the separation of protactinium-231 and its decay products is discussed. As a result of the investigation into residue adsorption techniques the following observations concerning protactinium are presented: (1) Hydrolysis and adsorption at the trace level are not unique characteristics of protactinium—they are exhibited by actinium at the nanogram level and by thorium and radium at the picogram level. (2) Hydrolysis and adsorption of protactinium are not inevitable and unpredictable, but occur under certain definite conditions having to do with the nature and concentration of the solvent. (3) Hydrolysis and adsorption of trace elements occur under conditions similar to those in which macroconcentrations of the same elements would tend to form precipitates in aqueous solution. (4) The method of residue adsorption, aside from its obvious potentialities in the carrier-free separation of trace elements, should prove useful in the study of the fundamental mechanism of the precipitation of slightly soluble compounds. P.V.E.

N64-15662 Oak Ridge National Lab., Tenn.
OBSERVATIONS ON THE BEHAVIOR OF PROTACTINIUM IN HCl-HF SOLUTIONS

J. M. Chilton *In* AEC, Washington Proc. of the Protactinium Chem. Symp., Gatlinburg, Tenn., Apr. 25–26, 1963 Feb. 1964 p 157–159 refs (See N64-15651 07-07) OTS: 2.75

A flowsheet was developed to separate uranium-232 from irradiated protactinium. The flowsheet was based on dissolving the Pa_2O_5 in a mixture of hydrochloric and hydrofluoric acids, loading the uranium on an anion exchange column, and finally eluting and further purifying the uranium. The protactinium was recovered from the ion exchange column raffinate by precipitation with ammonium hydroxide; the precipitate was filtered and ignited to Pa_2O_5. During the development and use of this flowsheet, a number of qualitative and semiquantitative observations were made relating to the behavior of protactinium, and these observations are presented in this report. Author

N64-15663 Institut du Radium, Paris (France)
THE CHEMISTRY OF PROTACTINIUM

G. Bouissieres, M. C. Ferradini, M. Garcon, R. Guillaumont, M. Hussonois et al *In* AEC, Washington Proc. of the Protactinium Chem. Symp., Gatlinburg, Tenn., Apr. 25–26, 1963 Feb. 1964 p 160–168 refs (See N64-15651 07-07) OTS: $2.75

Research concerned with solvent extraction of protactinium, preparation of metallic protactinium, and nuclear reactions in which protactinium is either the target element or the formed element is discussed. P.V.E.

N64-15671 Iowa State U. of Science and Tech., Ames
AN INFRARED STUDY OF THE TRIBUTYL PHOSPHATE-NITRIC ACID-WATER SOLVENT EXTRACTION SYSTEM

Patrick John Kinney (Ph.D. Thesis) and Morton Smutz Aug. 1963 167 p refs
(Contract W-7405 eng-82)
(IS-728) OTS: $2.75

The results of a detailed infrared study on the systems TBP (tributyl phosphate), HNO_3, TBP–HNO_3, TBP–HNO_3–CCl_4, and TBP–HNO_3–H_2O coupled with phase distribution data are interpreted in terms of the molecular interactions taking place in the solutions. A mechanism has been established for the extraction of nitric acid from an aqueous solution by TBP. A strong TBP·HNO_3 complex forms by hydrogen bonding at the P = O site of the TBP replacing the more weakly held water of a TBP·H_2O complex and causing the water content of the organic phase to decrease. Past a 1/1 HNO_3–TBP mole ratio in the organic phase, additional nitric acid is present in the solution through a mechanism of "solubility" of nitric acid in the strong TBP·HNO_3 complex. This solubility includes contributions from free HNO_3 as well as contributions from hydrogen bonding interactions between the additional acid and the TBP·HNO_3 complex, most probably involving P–O–C linkage. Author

N64-15687 Aerospace Corp., El Segundo, Calif.
MASS SPECTROMETRY AND THE PROPERTIES OF CONDENSED SYSTEMS AT HIGH TEMPERATURES
P. Breisacher 27 Dec. 1963 59 p refs
(Contract AF 04(695)-269)
(SSD-TDR-63-349; TDR-269(4210-10)-3; AD-429199)

A general discussion of the applicability of mass spectrometry toward the study of high-temperature systems is given. Specific attention is given to the methods of ion generation, experimental techniques, and interpretation of the results obtained. A summary of all work performed in this area of investigation during the last four years is given in tabular form. Author

N64-15688 Temple U., Philadelphia, Pa. Research Inst.
First Quarterly Progress Report, Oct. 1-Dec. 31, 1963 [ISOLATION AND IDENTIFICATION OF OXYGEN-FLUORINE RADICALS]
A. D. Kirshenbaum and A. V. Grosse 1963 15 p refs
(Contract AF 04(611)-9555)
(AD-428142)

The purpose of this program is to produce, isolate, and identify the OF, O_2F, and O_3F radicals. It is planned to prepare these radicals by two methods: (1) bombardment of OF_2, O_2F_2, O_3F_2, and O_2BF_4 with H atoms at 77° K or lower; and (2) irradiation of these compounds with Co^{60} gamma-rays at 77° K or lower. The current program status includes the following: (1) H atoms were produced at better than 90% yields by means of a Wood's electric-discharge apparatus. (2) The CF_4, when bombarded with H atoms, produced HF and C_2F_6; the latter was due to the recombination of the CF_3 radical. (2) The O_2F_2, when bombarded with H atoms, produced HF, H_2O_2, and H_2O. (3) The O_3 was separated from H-atom bombarded O_2BF_4 when the latter was warmed from 77° K to 135° K. (3) The difference between the electron paramagnetic spectrum of Co^{60} irradiated O_2F_2 and kept at 77° K and the spectrum of Co^{60} irradiated O_2F_2, upon warming from 77° K to 90° K and kept at 90° K for ten minutes, indicated that two or more species are involved and that one of these species was not stable at 90° K. I.v.L.

N64-15692 Calvin Coll., Grand Rapids, Mich.
SILVER MIGRATION AND TRANSPORT MECHANISM STUDIES IN SILVER OXIDE-ZINC BATTERIES Quarterly Technical Progress Report No. 3, 1 Nov. 1962-1 Feb. 1963
T. P. Dirkse and L. A. Vander Lugt 1963 20 p
(Contract AF 33(657)-8689)
(AD-296894)

A study has been made of three methods whereby radioactive silver can be used to determine quantitatively the concentration of small amounts of silver dissolved in potassium hydroxide solutions. Good results were obtained by precipitating the dissolved silver as silver iodide and collecting this on a filter paper of sufficiently small pore size. The precipitated silver iodide was then counted. Author

N64-15695 United States Rubber Co., Wayne, N.J. Research Center
PHOSPHONITRILIC POLYMERS STABLE AT HIGH TEMPERATURES First Quarterly Report, 1 Nov. 1963-31 Jan. 1964
Harold K. Garner, Gerald J. Klender, and Aspet Merijanian 31 Jan. 1964 24 p refs
(Contract NObs-90089)
(AD-429132)

The objective of this investigation is the development of new thermoplastic and thermosetting resins from phosphonitrilic chloride trimer for high temperature electrical applications. The preparation and polymerization of $P_3N_3(OC_6H_5)_{3.5}(OC_2H_5)_{1.25}Cl_{1.25}$ have been studied further. Difficulties in controlling the chlorine-to-ethoxy ratio in the intermediates have delayed the preparation of larger samples. Additional work on other phenoxy-blocked monomers has been accomplished, and polymerization studies were begun on monomers containing dimethylamino groups as blocking groups. Author

N64-15712 India. Dept. of Atomic Energy, Bombay
STUDIES ON THE PREPARATION OF ALUMINIUM NITRIDE
I. A. Khan, T. R. Bhat, and N. S. Krishna Prasad 1963 19 p refs
(AEET/CD/18)

The reaction between aluminum and nitrogen was investigated in detail using NaF, KHF_2, MgF_2, CaF_2 PbF_2, BiF_3, AlF_3 and CeF_3 as catalysts. The optimum conditions for the formation of aluminum nitride were found to be: catalyst = 5% KHF_2, temperature = 1,000° C; heating time = 3 hr. Under these conditions the product contained 94% to 96% of aluminum nitride. A method is also described for the preparation of aluminum nitride of low carbon content. Author

N64-15724 New Mexico U., Albuquerque, N. Mex.
OZONE MEASURING DEVICES Final Report, 27 Jan. 1960-31 Oct. 1962
Victor H. Regener 10 Dec. 1963 39 p refs
(Contract AF 19(604)-7211)
(AFCRL-64-212; AD-429514)

A description is given of the essential technical details of the chemiluminescent ozone balloon sonde and of its adaptation to ozone recordings from pressurized aircraft. A description of the ozone generator–calibrator and of the chemiluminescent surface recorder is also included. E.W.

N64-15797 Bureau of Mines, College Park, Md.
AMMONIACAL-AMMONIUM CARBONATE LEACHING OF MANGANIFEROUS MATERIALS FROM THE SOUTHERN DISTRICT, AROOSTOOK COUNTY, MAINE
Theodore L. Turner and Joseph H. Swift [1964] 38 p refs
(BM-RI-6368)

A study on a small laboratory scale was made of the use of ammoniacal-ammonium carbonate for batch leaching Mn from low-grade manganiferous materials (6% to 16% Mn) obtained

from deposits in the southern district of Aroostook County, Maine. These materials were partially reduced at 500° to 700° C with H_2 or CO and then leached with solutions of NH_3 and CO_2 dissolved in water. Extraction of 80% to 90% of the Mn was obtained from some sample materials, but 10% to 34% of the iron was also extracted. Material from the Littleton Ridge deposit contained manganese intimately associated with Fe, a condition that contributed to difficulties in obtaining a commercially acceptable product. Extensive investigations of the leach and reduction processes with various mixtures of H_2 and water vapor, and CO and CO_2, failed to disclose a set of conditions for selectively leaching the manganese. Finely divided metallic Fe was probably produced during the reduction steps, so that Fe was leached with the Mn in the subsequent extractions. Author

N64-15831 Bureau of Mines, Washington, D.C.
METATHESIS OF BASTNASITE AND SOLVENT EXTRACTION OF CERIUM
D. J. Bauer and V. E. Shaw 1964 20 p refs
(BM-RI-6381)

Bastnasite concentrate was processed to recover total rare-earth content and obtain high-purity ceric nitrate. Reaction of the concentrate with 45-percent caustic soda for 1 hr at 180° C in stainless steel vessels resulted in 99-percent conversion to rare-earth hydroxides. A drying step followed by solution in nitric acid produced a tetravalent cerium fraction amenable to extraction with TBP. Single-stage separatory funnel experiments resulted in 90-percent recovery of ceric nitrate at a purity of 99.9 percent. Fractional extraction in pressure-bubbler columns resulted in 98.5-percent recovery of 99.5-percent-pure ceric nitrate. Author

N64-15832 Bureau of Mines, Washington, D.C.
ANALYSIS OF HIGH-PURITY HAFNIUM BY OPTICAL EMISSION SPECTROGRAPHY
Lloyd Carpenter and Richard W. Lewis 1964 20 p refs
(BM-RI-6384)

The objective of the investigation was to determine spectrochemically 19 elements in the general range of 0.5 to 1,000 ppm in high-purity hafnium and its compounds. Samples were converted thermally to hafnium dioxide, mixed with buffer-carrier-internal standards, and excited by a d.c. arc. Spectra were recorded on photographic plates. Transmittance values were recorded densitometrically and converted to relative-intensity ratios. Four groups of standards were used to establish analytical curves from which the concentrations of impurities were obtained. Average precision of the method was 14.2 percent relative standard deviation, and relative error was 4.2 percent. Author

N64-15833 Hanford Atomic Products Operation, Richland, Wash.
OXIDATION OF A NICKEL-2% ThO_2 ALLOY AND THE LOGARITHMIC RATE LAW OF OXIDATION
D. A. Jones and R. E. Westerman Oct. 1963 34 p refs
(Contract AT(45-1)-1350)
(HW-79350) OTS: $0.75

The oxidation of pure nickel containing a dispersion of submicron size ThO_2 particles was investigated in the range 600° to 1000° C. At 600° and 700° C oxidation was described by a parabolic equation. At 950° and 1000° C a mixed parabolic relationship (partial control by an interface reaction) applied. Logarithmic oxidation, concurrent with a minimum in the oxidation rate, occurred at intermediate temperatures of 800°, 850°, and 900° C. The partially controlling interface reaction at 950° and 1000° C is interpreted to be activated adsorption of oxygen at the oxygen-oxide interface. A logarithmic rate law for oxide film formation is derived by considering oxygen adsorption as the controlling process. Author

N64-15835 Hanford Atomic Products Operation, Richland, Wash.
TRILAURYLAMINE EXTRACTION: SPECTROGRAPHIC DETERMINATION OF TANTALUM IN PLUTONIUM
Roy Ko Dec. 1963 11 p refs
(Contract AT(45-1)-1350)
(HW-79738)

Ion exchange and tributylphosphate extraction separations of tantalum from plutonium were tried. A trilaurylamine extraction–spectrographic method for the determination of tantalum in plutonium was developed. Plutonium was dissolved in HCl and separated by amine extraction from the undissolved tantalum and from any tantalum that might have dissolved. HF was then added to dissolve all the tantalum, and the solution was concentrated by evaporation. Niobium internal standard was added, and tantalum was determined in the aqueous phase by graphite spark spectrographic analysis. Concentrations of tantalum as low as 50 ppm in 50 mg of plutonium were determined with an estimated relative standard deviation of ±7%. Author

N64-15852 Iowa State U. of Science and Tech., Ames
VAPOR PRESSURES OF SOME AMINO ACIDS **Research and Development Report**
Dale Dean Clyde and Harry Svec Nov. 1963 37 p refs
(Contract W-7405-eng-82)
(IS-790) OTS: $1.00

The vapor pressures of several amino acids have been determined by the Knudsen cell effusion method. The standard thermodynamic quantities for the heat of sublimation, the entropy of sublimation, and the free energy of sublimation are calculated. The sensitivity of the mass spectrometer is calculated for an amino acid from its vapor pressure, its ionization cross section, and the intensity of the $(P\text{-}COOH)^+$ ion currents relative to the total ion intensity. Author

N64-15915 Hanford Atomic Products Operation, Richland, Wash.
CONTINUOUS MEASUREMENT OF TRACE CONCENTRATIONS OF AMMONIA IN WATER
T. F. Demmitt Oct. 1963 13 p refs
(Contract AT(45-1)-1350)
(HW-79296) OTS: $0.50

This report presents results obtained during evaluation of the alkaline phenol–sodium hypochlorite procedure for continuous measurement of trace concentrations of ammonia in water. The analytical procedure and instrumentation used are also described. The ammonia concentration range investigated was 0 to 25 ppm. The precision of the procedure is within ±10% at the 10-ppb level and ±2% at the 25-ppm level. This procedure is recommended for measurement of ammonia concentrations in aqueous process streams where NH_4OH is used for pH control. Author

N64-15923 Bureau of Mines, Albany, Ore.
PRELIMINARY STUDY OF INORGANIC REACTIONS IN A HIGH-GAMMA RADIATION FLUX
J. E. Tress, C. E. Wicks, and F. E. Block 1964 21 p refs
(BM-RI-6382)

Investigated were the effects of gamma radiation on materials and on chemical reactions to obtain information that could be of value in modern metallurgical practices. Various combinations of metals and their ores and compounds were irradiated in attempts to effect reactions that might be applicable in the extraction and separation of metal values from minerals and ores. The types of reactions studied included complexing of salts, decomposition of hydrated salts, metal chlorination reactions, leaching of ores and minerals, halogen exchange, and various reducing reactions. Author

N64-15925 Iowa State U. of Science and Tech., Ames Ames Lab
FORMATION CONSTANTS OF SOME RARE-EARTH COMPLEXES
William Ray Stagg (Ph.D. Thesis) and Jack E. Powell Aug. 1963
(Contract W-7405-eng-82)
(IS-727) OTS: $2.00

The stepwise formation constants for complexes between the trivalent metals lanthanum, yttrium, and all of the rare earths (except promethium) and the ligands isobutyrate (IBU), α-hydroxyisobutyrate (AHIB), and α, β, β'-trihydroxyisobutyrate (THIB) were measured at 25°C and an ionic strength of 0.5 M ($NaClO_4$). For lanthanum and the first half of the rare-earth series, the magnitude of the formation constants increased in the order IBU, AHIB, THIB. For the remainder of the series and yttrium, the magnitude increased in the order IBU, THIB, AHIB. The IBU and THIB complex formation constants both exhibit a sinusoidal behavior when plotted as a function of atomic number. Such a plot for the AHIB complexes increases more or less uniformly. Because of this, it was concluded that the AHIB would be the superior ligand to use as an eluant for ion-exchange chromatographic separation of rare-earth mixtures. Author

N64-15947 Ozark-Mahoning Co., Tulsa, Okla.
SYNTHESIS OF NEW FLUORINE CONTAINING COMPOUNDS Technical Report, 10 Oct. 1963-31 Dec. 1963
6 Jan. 1964 4 p
(Contract AF 04(611)-9556; ARPA Order 24, Amendment 65)
(AD-429480)

Investigations were conducted on: (1) the reactions of the oxides and fluorides of nitrogen with the larger group I and ammonium fluorides; and (2) the reactions of fluorine and trifluoro-chlorine with the nitrates of the group I elements. The work considered only the solid phase of chemistry.
C.L.W.

N64-16031 Atomic Energy Commission, Washington, D.C. Div. of Technical Information
EMISSION SPECTRUM ANALYSIS OF ATOMIC MATERIALS, BOOKS 1 AND 2
A. N. Zaidel, N. I. Kaliteevskii, L. V. Lipis, and M. P. Chaika 1960 733 p refs Transl. from publ. of the State Publ. House of Physicomath. Lit., Moscow, 1960
(AEC-TR-5745, Books 1 and 2) OTS: $7.50, the 2 books

This book deals with the use of applied spectroscopy in analyzing pure materials and is divided into the following sections: (1) Fundamentals of Spectrum Analysis and Apparatus—Fundamentals of Emission Spectrum Analysis, Sensitivity and Accuracy of Spectrum Analysis, Standardization and Preparation of Samples, Spectral Instruments, Light Sources; (2) Methods of Spectrum Analysis—Simplest Methods of Analyzing Elements With Complex Spectra, The Fractional Distillation Method, The Evaporation Method, Special Methods of Spectrum Analysis, The Use of Chemical Enrichment of Samples in Spectrum Analysis, Determination of Certain Rare Earth Elements in Atomic Materials; and (3) Spectrum Analysis of Isotopic Composition—Isotopic Analysis According to Atomic Spectra, Analysis According to Molecular Spectra, The Spectrum-Isotopic Method. P.V.E.

N64-16033* Geophysics Corp. of America, Bedford, Mass.
SOLIDS MASS SPECTROMETER First Quarterly Technical Progress Report, 4 Nov. 1963-3 Feb. 1964
[1964] 21 p
(NASA Contract NASw-839)
(NASA CR-55774) OTS: $2.60 ph, $0.83 mf

The background of the present ion source was measured with a highly sensitive analyzer that uses an electron multiplier for the detection of the ions. A new ion source was designed and built utilizing spectroscopically pure materials to minimize the source of background. The vacuum and gas inlet systems were rebuilt to reduce ultimate pressure and hydrocarbon contamination in order to investigate the feasibility of using the instrument for analysis of organic material. Author

N64-16035* California U., La Jolla
ULTRA-VIOLET SPECTRA OF ORGANIZED ELEMENTS
Barthalomew Nagy (Fordham U.), Kurt Fredriksson, Jan Kudynowski, and Leon Carlson (Karolinska Inst.) Repr. from Nature, v. 200, no. 4906 Nov. 9, 1963 p 565-566 refs
(NASA Grant NsG-341; NASA Grant NsG-98-60)

The ultraviolet absorption spectra of the acid-insoluble residues of individual "organized elements" (from the Orgueil carbonaceous meteorite) were examined with an ultramicrospectrograph. Generally, the spectra of individual organized elements showed absorption bands in the 2,600 A to 2,800 A wavelength range. Chloroform extraction of the organized elements did not appear to change their spectra, suggesting that the acid-insoluble residues were not composed of bituminous matter or of low-molecular-weight hydrocarbons. The "organized elements" were opaque in the ultraviolet range before acid leaching was utilized to remove the mineral content. P.V.E.

N64-16077 Callery Chemical Co., Pa.
STUDIES OF COMPLEX PERCHLORATES Annual Report
C. R. Gulbert and A. D. Mc Elroy 10 Feb. 1964 37 p refs
(Contract Nonr-3943(00))
(AD-430803)

Results of continuing investigations of complex perchlorates are reported. Four new compounds, $NH_4Al(ClO_4)_4$, $NO_2Al(ClO_4)_4$, $NO_2Zn(ClO_4)_3$, and $LiZn(ClO_4)_3$ were prepared in good purity, and a less pure complex of titanium ($(NO_2)_2Ti(ClO_4)_6$) was synthesized. Various properties of these and other available compounds were studied. Author

08 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications blackout; telemetry; tracking; and wave propagation. *For tracking stations see*: 10 Facilities, Research and Support. *For related information see* 06 Auxiliary Systems; 09 Electronics; 15 Instrumentation and Photography; and 22 Navigation and Guidance.

N64-15062 Aerospace Corp., El Segundo, Calif. Telecommunications and Tracking Dept.
TRACKING, TELEMETRY, AND COMMAND STUDIES OF GROUND AND SATELLITE SUBSYSTEMS. VOLUME I: SUMMARY
F. R. Gerardi Dec. 1963 16 p
(Contract AF 04(695)-269)
(SSD-TDR-63-334, Vol. I; TDR-269(4110-01)-13, Vol. I; AD-429305)

The investigation was divided into the following categories: (1) A Comparison of Several Ranging Systems Designed for Military Space Applications; (2) Airborne Transponder Configuration Study; (3) Ground Station Antenna Survey; (4) Acquisition of Space Vehicles by Ground Tracking Systems; (5) Parametric Analysis of Tracking, Telemetry, and Command Subsystems. Author

N64-15128 Naval Research Lab., Washington, D.C.
AN EXPERIMENTAL 600-FOOT ELECTRO-SONIC DELAY LINE FOR THE NAVY SPACE SURVEILLANCE SYSTEM
M. G. Kaufman 22 May 1963 15 p refs
(NRL-5927; AD-409494)

The requirement for delaying the composite (IRIG) FM telemetering signals from a Space Surveillance site by one-half second was fulfilled by converting the phone-line frequencies into sound, which is then transmitted through a pipe long enough to provide the desired delay and reconverted into electrical signals. The delayed output is essentially distortionless. Author

N64-15130 Naval Research Lab., Washington, D.C.
THE USE OF AN HF LUNAR REFLECTION CIRCUIT IN THE STUDY OF IONOSPHERIC ELECTRON DENSITY
J. R. Davis and F. H. Utley 19 Jul. 1963 15 p refs
(NRL-5968; AD-414850)

A high-power HF transmitter has been used to illuminate the moon at moonrise. The returned signals that have been observed display both the smooth-sphere scattering components and the rough-scatterer components reported previously by observers utilizing the VHF and UHF bands. The received moon echoes were subjected to a high degree of predetection bandwidth narrowing and were analyzed to yield information regarding the possible extent of polarization-rotation undergone by radio waves traversing the ionosphere. The rotation of the plane of polarization has been found, on each occasion, to have a distinct echo-fading frequency as the ray path rises through the ionosphere. In the present investigation, the fading period varied from 90 to 113 seconds. Author

N64-15131 Joint Publications Research Service, Washington, D.C.
PRINCIPLES OF CONTINUOUS-WAVE RADAR
A. S. Vinitskiy 6 Feb. 1964 731 p Transl. into ENGLISH of the book "Ocherk Osnov Radiolokatsii pri Nepreryvnom Uzluchenii Radiovoln", Leningrad, 1961 p 1-474
(JPRS-23120; OTS-64-21507) OTS: $8.25

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N64-15132 Joint Publications Research Service, Washington, D.C.
INTRODUCTORY REMARKS
A. S. Vinitskiy *In its* Principles of Continuous-Wave Radar 6 Feb. 1964 p 8-14 (See N64-15131 07-08) OTS: $8.25

Radar detection and the determination of target coordinates can be realized with signals beamed in short packets (pulses) also with continuous wave signals. In "passive" radar, the radar contains receivers that catch the electromagnetic waves radiated by the target itself. The target coordinates are most frequently determined by comparing the characteristics of the target signals received directly and those reflected from the earth's surface, and also by means of direction-finding methods. In order to "notch" the time of radiation of the radar signal and its return from the target, it is necessary to produce on the radio wave some set of "incisions"; in pulse radar, this is done

by beaming the oscillations in short packets (pulses). The direct and reflected signals differ in time. The measurement of the distance reduces to the measurement of the time interval between the radiated pulses and those reflected from the target. In CW radar, the direct and reflected signals cannot be separated in time. The measurement of the distances reduces to the measurement of the frequency interval between radiated and reflected signals. I.v.L.

N64-15133 Joint Publications Research Service, Washington, D.C.

SOME BASIC CONCEPTS

A. S. Vinitskiy *In its* Principles of Continuous-Wave Radar 6 Feb. 1964 p 15–121 (See N64-15131 07-08) OTS: $8.25

This report discusses: (1) modulated oscillations per se; (2) coherent oscillations; (3) quasi-coherent oscillations; (4) the possibility of interference of quasi-coherent oscillations; (5) the applicability of the law of power addition in the analysis of quasi-coherent oscillations; (6) continuous and pulsed, coherent, and incoherent operating modes of radar stations; (7) the reliability of a radar channel (interference immunity and signal-to-noise ratio); (8) the autocorrelation function and conditions of structural homogeneity of modulated oscillations; (9) the autocorrelation function and conditions of structural homogeneity of fluctuation noise; and (10) a method of interference-immune reception of almost autocoherent signals. I.v.L.

N64-15134 Joint Publications Research Service, Washington, D.C.

MOTION OF RADAR TARGET AND MINIMUM ATTAINABLE RECEIVER BANDWIDTH

A. S. Vinitskiy *In its* Principles of Continuous-Wave Radar 6 Feb. 1964 p 122–138 (See N64-15131 07-08) OTS: $8.25

A modulated radar signal occupies on the frequency scale a certain, rather broad band that is determined by the law of modulation. It is frequently regarded as self-evident that it is precisely this width of the signal spectrum that determines the minimum attainable bandwidth of the radar receiver. However, it is not the transmitter-signal spectrum but the variation of the target coordinates that imposes the main limitations on the minimum attainable bandwidth of the radar receiver. This variation is not known to the operator beforehand; and, because of this, it converts the oscillations reflected from the target into a signal that carries some new information concerning the target. One of the most important causes of the discrepancy between the minimum attainable and practically realizable bandwidths of radar receivers is the difficulty in the realization of filters that are optimal for the chosen form of the transmitter signal. I.v.L.

N64-15135 Joint Publications Research Service, Washington, D.C.

CONDITIONS FOR OPTIMUM FILTERING IN THE UHF CHANNEL OF A RADAR RECEIVER

A. S. Vinitskiy *In its* Principles of Continuous-Wave Radar 6 Feb. 1964 p 139–203 (See N64-15131 07-08) OTS: $8.25

The solution to the problem of optimum detection and recognition of a pulse radar signal, against the background of noise, is that the amplitude frequency should coincide with the envelope of the spectrum of the input signal, and the phase frequency characteristic of the filter should be the inverse of the phase frequency characteristic of the signal spectrum. In other words, the transfer coefficient of an optimal filter should be the complex conjugate of the spectrum of the input filter. Therefore, in pulse radars, conjugate filters can be used successfully, not only in the channel ahead of the second detector but also in the video channel. In CW radars, it is usually necessary not only to separate the signal against the noise and to reproduce it in the mean but also to make a sufficiently accurate reproduction, at the output of the filter, of the waveform of the useful signal. Linear filters with variable parameters are used. For the signal of an FM radar operating in the CW mode, an adequate filter is a tracking filter. In addition, adequate filtering of a radar FM signal is possible when the tracking filter is replaced by the simpler harmonic filter. This has led to extensive application of tracking heterodynes in CW radars. I.v.L.

N64-15136 Joint Publications Research Service, Washington, D.C.

SOME FEATURES OF FILTERING IN A RECEIVING CIRCUIT CONTAINING NONLINEAR ELEMENTS

A. S. Vinitskiy *In its* Principles of Continuous-Wave Radar 6 Feb. 1964 p 204–236 (See N64-15131 07-08) OTS: $8.25

It is indicated that, in the practically important cases, when at a point A, $(P_s/P_n)A$ (the signal-to-noise ratio at point A) is $<<1$, the narrowing of the bandwidth of the video channel improves the excess of the signal along the noise in a much less effective way than a similar narrowing of the bandwidth of any portion of the high-frequency channel. This result is valid not only for the case of filtering, but for any type of coherent accumulation. In particular, for incoherent-pulse stations in which the coherent accumulation is possible only beyond the second detector, the interference immunity attainable for a specified observation time is lower than in the case of the coherent-pulse or continuous-wave operating mode of the station. I.v.L.

N64-15137 Joint Publications Research Service, Washington, D.C.

ENERGY EQUIVALENCE OF PULSE AND CW RADAR SIGNAL TRANSMISSSION

A. S. Vinitskiy *In its* Principles of Continuous-Wave Radar 6 Feb. 1964 p 237–249 (See N64-15131 07-08) OTS: $8.25

The fundamental range equation of radar is discussed in conjunction with the analysis of pulse and CW signal transmission for a stationary antenna. Also presented is the analysis of pulse and CW transmission of signals in angle scanning. I.v.L.

N64-15138 Joint Publications Research Service, Washington, D.C.

RADAR DETECTION OF SINGLE TARGETS USING THE DOPPLER EFFECT

A. S. Vinitskiy *In its* Principles of Continuous-Wave Radar 6 Feb. 1964 p 250–281 (See N64-15131 07-08) OTS: $8.25

The regions of application of the Doppler effect in radar detection are discussed for pulse and CW radars. I.v.L.

N64-15139 Joint Publications Research Service, Washington, D.C.

RADAR LOCATION OF A SINGLE TARGET USING FREQUENCY MODULATION

A. S. Vinitskiy *In its* Principles of Continuous-Wave Radar 6 Feb. 1964 p 282–379 (See N64-15131 07-08) OTS: $8.25

Radar location of a single target, using frequency modulation, is reviewed. Emphasized are the following: (1) the determination of the distance to a single target with a symmetrical

sawtooth frequency modulation of the transmitter; (2) asymmetrical sawtooth modulation, sawtooth modulation with "instantaneous" return; (3) nonlinear sawtooth modulation; (4) a general case of nonlinear frequency modulation; (5) the shaping of a converted signal; (6) different methods for the quasi-representation of processes in FM radars; (7) the constant error of FM radar (discreteness and nonuniqueness of the reading of the range); and (8) the conditions in the inversion zones of the modulation curve. I.v.L.

N64-15140 Joint Publications Research Service, Washington, D.C.

FEATURES OF CIRCUITS OF THE HIGH FREQUENCY BLOCKS AND UNITS OF CW RADARS

A. S. Vinitskiy *In its* Principles of Continuous-Wave Radar 6 Feb. 1964 p 380–402 (See N64-15131 07-08) OTS: $8.25

Circuits of receiving devices in CW radars are discussed. These circuits are: (1) a circuit in which a low-Doppler-frequency signal is immediately separated at the output of the UHF mixer; (2) modifications of (1) that include a circuit with automatic tuning of the heterodyne and a circuit for heterodyning with a sideband component; (3) circuits for receivers of FM radars that include a circuit with automatic tuning of the tracking heterodyne, a circuit with heterodyning with a sideband component, and a circuit with a tracking filter for the sideband frequency. I.v.L.

N64-15141 Joint Publications Research Service, Washington, D.C.

FEATURES OF CIRCUITRY OF LOW FREQUENCY BLOCKS AND UNITS OF CW RADARS

A. S. Vinitskiy *In its* Principles of Continuous-Wave Radar 6 Feb. 1964 p 403–443 (See N64-15131 07-08) OTS: $8.25

Features are given of the following circuitry of low-frequency blocks and units of CW radars: (1) circuits for the conversion of data on target range and velocity (circuitry of frequency counters, frequency discriminators, and autocorrelators); (2) a circuit for tracking in range with automatic regulation of the modulation parameters; (3) a circuit with automatic tuning of a low-frequency tracking heterodyne; and (4) a frequency tracking circuit with a velodyne. I.v.L.

N64-15142 Joint Publications Research Service, Washington, D.C.

SOME SPECIAL CIRCUITS OF FM RADARS FOR SINGLE TARGETS

A. S. Vinitskiy *In its* Principles of Continuous-Wave Radars 6 Feb. 1964 p 444–473 (See N64-15131 07-08) OTS: $8.25

A circuit with a small shift of the heterodyne frequency eliminates constant error, but is incapable of eliminating the critical-velocity effect. A circuit with multiple heterodyning eliminates constant error, and offers the possibility of continuously measuring the shortest ranges (smaller than 50 cm) with a small frequency deviation and a simple modulation law. In addition, the circuit also eliminates the phenomenon of critical velocity, and makes it possible to work with a wide range of variation in the velocities and distances. A circuit with double frequency modulation can effect the elimination of the phenomenon of constant error and critical velocity by producing the required shift in the frequency without the use of multiple heterodyning. However, the circuit has many shortcomings not found in the circuit with multiple heterodyning. I.v.L.

N64-15143 Joint Publications Research Service, Washington, D.C.

ELECTRONIC SPECTRUM ANALYZERS AND FEATURES OF THEIR USE IN RADAR SETS FOR SCANNING IN DISTANCE AND VELOCITY

A. S. Vinitskiy *In its* Principles of Continuous-Wave Radars 6 Feb. 1964 p 474–532 (See N64-15131 07-08) OTS: $8.25

Spectrum analyzers, in general, resolve a complicated signal into a harmonic spectrum. However, there are analyzers that resolve a complex signal into a spectrum of functions such as the Hill-type functions. For FM radars, the following methods of spectral analysis for range scanning are discussed: (1) simultaneous analysis, wherein the accumulation of the signal in all resonators is carried out simultaneously; (2) sequential analysis with a tunable resonator; (3) sequential analysis with a tunable heterodyne; (4) sequential analysis with variable modulation frequency; and (5) sequential analysis with a variable frequency modulation swing. For velocity scanning, only methods (1), (2), and (3) are applicable. I.v.L.

N64-15144 Joint Publications Research Service, Washington, D.C.

COMPARISON OF DIFFERENT DISTANCE-SCANNING CIRCUITS

A. S. Vinitskiy *In its* Principles of Continuous-Wave Radars 6 Feb. 1964 p 533–574 (See N64-15131 07-08) OTS: $8.25

A comparison is made between simultaneous and sequential distance-scanning circuits. It is indicated that the most convenient relationships in distance scanning are attained in a coherent-pulse station, using an FM radar and simultaneous frequency for $T_{del} << T_{rep}$, i.e., $\rho << 1$. (T_{del} is the delay time, and T_{rep} is the repetition period.) When ρ increases considerably, the efficiency of operation of the FM station with simultaneous analysis decreases, and the limiting operation range becomes smaller. Both the coherent-pulse and the FM station, with simultaneous analysis, make it possible to select separately and independently the limiting range and the resolution in range. Incomparably simpler than the simultaneous analysis circuit are all variants of FM station circuits with sequential frequency analysis. To ensure satisfactory energy relations in all such circuits, the variation of the regulated parameter is in accordance with a stepwise law. I.v.L.

N64-15145 Joint Publications Research Service, Washington, D.C.

BASIC RELATIONSHIPS IN SCANNING A GROUND AREA BY MEANS OF A CONTINUOUS WAVE RADAR

A. S. Vinitskiy *In its* Principles of Continuous-Wave Radars 6 Feb. 1964 p 575–633 (See N64-15131 07-08) OTS: $8.25

The conditions for the formation of either Doppler or range-measuring spectra, upon reflection of radio waves from such extensive objects as the earth's surface, differ greatly from those conditions for the formation of converted signals reflected from "pointlike" targets. This report deals with the analysis of process formation of the spectra of signals reflected from the earth's surface, a determination of the quantitative characteristics for the simplest single-beam system, and the features of circuits used in autonomous onboard radar devices. I.v.L.

N64-15146 Joint Publications Research Service, Washington, D.C.

AIRBORNE INSTRUMENTS FOR MEASURING GROUND SPEED AND DRIFT ANGLE, OPERATING WITH CW RADIO WAVES

A. S. Vinitskiy *In its* Principles of Continuous-Wave Radars 6 Feb. 1964 p 634–670 (See N64-15131 07-08) OTS: $8.25

The most reliable and exact means of measuring ground velocity and drift angle is by the use of an airborne Doppler radar. This report discusses single- and multi-beam Doppler meters and associated circuitry. Also discussed are the antenna system of the airborne Doppler station and its stabilization, and the Doppler station as part of an autonomous navigational system. I.v.L.

N64-15147 Joint Publications Research Service, Washington, D.C.

AIRBORNE RADIO ALTIMETERS OPERATING WITH CW RADIO WAVES

A. S. Vinitskiy *In its* Principles of Continuous-Wave Radars 6 Feb. 1964 p 671–683 (See N64-15131 07-08) OTS: $8.25

Frequency modulation is used to measure the distance to the earth's surface in CW radio altimeters. The narrowest spectrum of range-measuring frequencies is obtained in the case of normal illumination of the earth's surface, which also ensures minimum Doppler shifts of the spectrum and the most convenient energy relationships. In this connection, single-beam antenna systems with vertical direction of the directivity-pattern axis are used in FM radio altimeters. The spectrum of the converted signal is then asymmetrical, and its width is determined by the width of the antenna directivity pattern. The use of broad directivity patterns makes it possible to ensure, by simple means, the operation of the radio altimeter with banking of the airplane, without resorting to stabilization of the antenna system. The random error, determined by the finite width of the range-measuring spectrum, is proportional to the width of the spectrum, i.e., to the width of the directivity pattern of the antenna. Therefore, it is not desirable to make the directivity pattern exceedingly broad. I.v.L.

N64-15148 Joint Publications Research Service, Washington, D.C.

CALIBRATION OF CW RADAR [0.8]

A. S. Vinitskiy *In its* Principles of Continuous-Wave Radars 6 Feb. 1964 p 684–715 (See N64-15131 07-08) OTS: $8.25

This report includes discussions of: (1) distance calibration that covers a method of calibrated signal time delay, methods for determining the range sensitivity, and a method of producing a standard-frequency comb; (2) velocity calibration by the "squirrel cage" method; (3) combined velocity and distance calibration; (4) the simulation of the Doppler or range-measuring frequency spectrum in the testing of radar stations; and (5) self-calibration in range. I.v.L.

N64-15149 Joint Publications Research Service, Washington, D.C.

SOME SPECIAL APPLICATIONS OF CW RADARS

A. S. Vinitskiy *In its* Principles of Continuous-Wave Radars 6 Feb. 1964 p 716–723 (See N64-15131 07-08) OTS: $8.25

Radar speedometers are small-size Doppler radar stations having continuous radiation, and intended for the registration of the speed of automobiles. The chief limiting characteristic of such speedometers is the reduced reliability of their operation in the case of a large car density (in the presence of many targets). Radio spectroscopy, the measurement of temperatures by determining the radiation of bodies in the radio range of the spectrum, etc., are connected with several valuable properties of the radio range of electromagnetic radiations, in which the attainable resolution of frequency is much better than in optics. The measurements of frequencies and phases of the individual components of the oscillations are possible, and the system of indication is flexible and convenient. In addition, the radiation of different substances in the radiofrequency band yields valuable supplementary information concerning the properties and structure of these substances. Also, Doppler radar installations are being used for the registration of the velocity of propagation of the front of a detonation wave. I.v.L.

N64-15186* Ohio State U. Research Foundation, Columbus Antenna Lab.

THEORETICAL AND EXPERIMENTAL ANALYSIS OF THE ELECTROMAGNETIC SCATTERING AND RADIATIVE PROPERTIES OF TERRAIN, WITH EMPHASIS ON LUNAR-LIKE SURFACES Semi-Annual Report, 1 May–31 Oct. 1963

1 Nov. 1963 26 p refs

(NASA Grant NsG-213-61)

(NASA CR-55545; Rept. 1388-12) OTS: $2.60 ph, $0.98 mf

Relations between the electromagnetic scattering properties of a surface (in particular the lunar surface) and its surface structure were examined. Measurements of the complete bistatic scattering pattern of a number of rough surfaces were carried out at X-band. Theoretical studies have been made of the polarization transformation properties of rough surfaces, and these have been used to interpret lunar scattering measurements made with linear polarization. Other studies of the lunar scattering problem have been concerned with the relation between spectrum and angular dependence (for CW scattering experiments) and with the correlation properties of the scattered signal (for two-frequency scattering experiments). Author

N64-15315 Radio Corp. of America, Patrick AFB, Fla.

MISTRAM

K. E. Relf *In* AF Missile Test Center New Data Reduction Methods to Improve Range Data [1963] p 55–109 (See N64-15312 07-01)

A general description of the MISTRAM system, a more detailed description of the precision measuring subsystem, an outline of the data reduction process, and a discussion of the performance accuracy of the system are presented. Other subsystems described include the airborne transponder, acquisition and tracking, analog computer, data transmission and recording, radiofrequency communication link, and data multiplex subsystems. J.E.T.

N64-15321 Radio Corp. of America, Patrick AFB, Fla.

RADAR ANALYSIS PROGRESS

A. E. Hoffman-Heyden *In* AF Missile Test Center New Data Reduction Methods to Improve Range Data [1963] p 225–259 (See N64-15312 07-01)

The radar systems evaluation activities during the past year covered studies of the operational accuracy of several AN/FPS-16 radars, which not only permitted consolidation of the present accuracy capabilities, but also revealed areas of error and tracking problems that require continued efforts towards adequate solution. In supporting the AMR radar activities, a variety of problems in the categories of Systems Application, Data Utilization, and Operational Techniques were dealt with. To illustrate these efforts in improving the AMR radar utility, highlights are presented on the subjects of reflectivity measurements as the "4th data coordinate," refinements in terminal trajectory coverage, and experience from MERCURY radar operations. Author

N64-15364 Ohio State U. Research Foundation, Columbus Antenna Lab.

DIFFRACTION AND FOCUSING OF PARTIALLY COHERENT RADIATION BY A CIRCULAR APERTURE

John G. Meadors 15 Nov. 1963 32 p refs

(Contract AF 33(657)-10824)

(Rept. 1579-4; AD-428764)

Diffraction patterns of a circular aperture illuminated by partially coherent light can be calculated for several types of correlation functions and radially varying intensities. Using Wolf's formulation of the theory of coherence, analytic expressions are obtained for the radiation pattern in the Fraunhofer region of a circular aperture under the assumption of quasi-monochromatic uniform and nonuniform illumination for a particular correlation function. Also the angular resolution and the focusing of a circular lens in the diffraction limit for two modes of illumination and four typical correlation functions are investigated. The results, shown graphically, have applications in the collimation and focusing of partially coherent light emitted by lasers.

Author

N64-15424 Defence Research Telecommunication Establishment, Ottawa (Canada) Communications Lab.

AN 8.6 mm SHORT-PULSE RADAR FOR INDOOR MODEL MEASUREMENTS

T H. Legg, R. A. Hayami, and R. I. Primich May 1962 23 p refs

(DRTE-1085)

The duration of the pulse is short enough (about 15 mμsec) to resolve the reflections from scatterers 10 feet or more apart. Separate transmitting and receiving antennas allow forward and back scattering and the polarization of the scattered signals to be studied. The minimum cross section that can be measured is limited by the reflections from the styrofoam tower used to support the models. Tunnel antennas with low side lobes are used to keep the peaks in the radar cross section of the tower below 0.007 cm^2. They also provide an isolation of about 130 db between the transmitter and receiver. The peak transmitter power is about 30 kw, the tangential sensitivity of the receiver is −52 dbm, and the dynamic range is 50 db. Measurements using square plates and a series of spheres as scatterers show that the equipment records radar cross section with an accuracy of one db over the full dynamic range of the equipment.

Author

N64-15426 Advisory Group for Aeronautical Research and Development, Paris (France)

THE EFFECT OF DISTURBANCES OF SOLAR ORIGIN ON COMMUNICATIONS

G. J. Gassmann, ed. (AFCRL) New York, Pergamon Press, 1963 358 p refs Papers presented at 6th Ann. Symp. of Ionospheric Res. Comm., Agard Avionics Panel, Naples, 1961 (AGARDograph 59)

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3. INFLUENCE OF SOLAR PARTICLE RADIATIONS ON ARCTIC HF PROPAGATION L. Owren (Alaska U.) p 25–36 refs (See N64-12421 04-28)

4. IONOSPHERIC POLAR BLACKOUTS AND RADIO COMMUNICATION DISTURBANCES T. Obayashi (Arctic Inst. of N. Am.) p 37–45 refs (See N64-15429 07-12)

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7. THE INFLUENCE OF POLAR BLACKOUTS ON VLF CIRCUITS B. Landmark (Norweg. Defence Res. Estab.) p 65–77 refs (See N64-15432 07-08)

8. THE INFLUENCE OF SOLAR DISTURBANCES ON VLF RADIO WAVE PROPAGATION OVER A LONG HIGH-LATITUDE PATH A. Egeland, B. Hultqvist, and J. Ortner (Kiruna Geophys. Obs.) p 79–100 refs (See N64-15433 07-08)

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21. ON THE 27 DAYS RECURRENCE TENDENCY OF RADIO PROPAGATION DISTURBANCES IN THE PERIOD OF HIGH SOLAR ACTIVITY A. Ochs and B. Beckmann (Deutsche Bundespost) p 235–244 refs (See N64-15446 07-28)

22. CLASSIFICATION OF IONOSPHERIC STORM TYPES (AND TYPE-DEPENDENCE ON SOLAR-GEOMAGNETIC PHENOMENA) R. J. Cormier (AFCRL) p 245–259 refs (See N64-15447 07-28)

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24. RADIO PROPAGATION QUALITY IN THE NORTH ATLANTIC AREA 1953–1960 M. E. Nason (NBS) p 287–291 (See N64-15449 07-08)

25. CIRCUIT RELIABILITY, FREQUENCY UTILIZATION AND FORECASTING IN THE HIGH FREQUENCY COMMUNICATION BAND J. H. Nelson (RCA Commun., Inc.) p 293–301 (See N64-15450 07-08)

26. ON THE EFFECT OF SOLAR DISTURBANCES ON THE LOW-RADIO-FREQUENCY IONOSPHERE REFLECTION PROCESS J. R. Johler and J. D. Harper, Jr.(NBS) p 303–334 refs (See N64-15451 07-28)

N64-15431 Norwegian Defence Research Establishment, Kjeller

A NOTE ON HF COMMUNICATIONS DURING POLAR RADIO BLACKOUTS

K. Folkestad and B. Landmark *In* Agard, Paris The Effect of Disturbances of Solar Origin on Commun. 1963 p 59–64 refs (See N64-15426 07-08)

(Contract AF 19(604)-5574; Contract AF 61(052)-08)

Some preliminary results are presented from a study of HF transpolar propagation conditions. Transmissions from College, Alaska, on 12 and 18 Mc/s, received at Kjeller have been analyzed. Distinction has been made between days that are either disturbed or rather quiet, and the selection has been based on results from riometer observations. The possibility of reducing the importance of the polar disturbances by means of relaying technique is also discussed; this analysis is also based on results from riometer observations. Author

N64-15432 Norwegian Defence Research Establishment, Kjeller

THE INFLUENCE OF POLAR BLACKOUTS ON VLF CIRCUITS

B. Landmark *In* Agard, Paris The Effect of Disturbances of Solar Origin on Commun. 1963 p 65–77 refs (See N64-15426 07-08)

(Contract N 62558-2025(x); Contract N 62558-2380(x))

Some results are presented from a study of the behavior of long-distance VLF circuits during polar radio blackout conditions, as compared with quiet conditions. There are at least two major types of polar radio blackouts. The most common type, which is normally referred to as the auroral type, is closely related to magnetic disturbances, and occurs most often near the zones of maximum auroral activity. The results of the study indicate that these disturbances have no great effect on the VLF circuits. The other type of polar balckout, which is normally referred to as polar-cap-type events or proton events, is not closely related to magnetic activity, and occurs over most of the polar cap simultaneously. During these events, a significant reduction of the strength of the VLF signals has been observed. Author

N64-15433 Kiruna Geophysical Observatory (Sweden)

THE INFLUENCE OF SOLAR DISTURBANCES ON VERY LOW FREQUENCY RADIO WAVE PROPAGATION OVER A LONG HIGH-LATITUDE PATH

Alv Egeland, Bengt Hultqvist, and Johannes Ortner *In* Agard, Paris The Effect of Disturbances of Solar Origin on Commun. 1963 p 79–100 refs (See N64-15426 07-08)

(Contract AF 61(052)-418)

This paper deals with the effects of solar and terrestrial disturbances on the propagation conditions on 16 kc/s radio waves between Rugby, England (lat. 52.2° N) and Kiruna, Sweden (lat. 67.8° N), a distance of about 2,100 km. The principal findings of the investigation are as follows: (1) Between September 1958 and March 1961 there were 14 periods during which the signal strength of VLF radio waves showed little or no diurnal variation. (2) SIDs do not influence the signal strength of 16 kc/s radio waves on the high-latitude path studied. (3) No direct correlation between sunspot numbers and the yearly average VLF field strength has been found. (4) It has not been possible to demonstrate a close correlation between the occurrence of abnormal VLF propagation and magnetic storms not associated with PCA, although there is some indication that major magnetic disturbances may affect the propagation of VLF waves. (5) No "blackout" periods were noted during the whole observation period, although a large number of major ionospheric disturbances occurred. (6) An auroral D-layer may influence the propagation conditions for VLF radio waves considerably. Author

N64-15434 Kiruna Geophysical Observatory (Sweden)

INFLUENCE OF SOLAR FLARES ON TRANSARCTIC HF PROPAGATION

Johannes Ortner *In* Agard, Paris The Effect of Disturbances of Solar Origin on Commun. 1963 p 101–107 refs (See N64-15426 07-08)

(Contract AF 61(052)-418)

From the observed effects of solar flares on the transpolar hf transmissions between College, Alaska, and Kiruna, Sweden, the following conclusions have been reached: (1) SIDs have only been observed in summer accompanying importance 3 and 3+ solar flares. (2) Flares emitting solar protons with relativistic velocities were followed by absorption starting a few hours after the flares and lasting for several days. (3) The correlation of absorption with geomagnetic activity as observed for Kiruna seems to be fairly good for the 18 Mc/s receptions. Author

N64-15441 Geona U. (Italy) Inst. Geophysics and Geodetics

SOLAR EFFECTS ON RADIO WAVE PROPAGATION

M. Bossolasco and A. Elena *In* Agard, Paris The Effect of Disturbances of Solar Origin on Commun. 1963 p 177–183 refs (See N64-15426 07-08)

Some results regarding the reception of WWV signals (on 15 Mc/s) at Genova are presented. They demonstrate that the daily variation of the intensity of the signals, represented by the MUF (4000) *F2* is well controlled. For nighttime observations for the first four months of 1961, the correlation coefficient between the WWV-intensity and the MUF was found to be 0.87. Author

N64-15444 Avco Corp., Wilmington, Mass. Research and Advanced Development Div.

THE PROBLEM OF ARCTIC COMMUNICATIONS FOLLOWING SOLAR DISTURBANCES

S. C. Coroniti, G. E. Hill, and R. Penndorf *In* Agard, Paris The Effect of Disturbances of Solar Origin on Commun. 1963 p 207–228 refs (See N64-15426 07-08)

(Contract AF 19(604)-4092)

Analysis of polar ionosonde data for 5 solar-induced ionospheric storms shows that the reflecting and the absorbing ionospheric layers vary in a fixed, predictable, and complex pattern. This spatial and time behavior of the ionospheric layers has been used to design hypothetical HF polar communication links that are reliable during quiet and disturbed periods of the ionosphere. It was found that by the use of a frequency

and link switching technique (FLS), communication to the middle latitudes and within the polar area was indeed theoretically possible even during an intense polar cap blackout. This FLS technique is discussed from an operational point of view. Results obtained from field experiments carried out in the polar region are discussed. Author

N64-15449 National Bureau of Standards, Boulder, Colo. Central Radio Propagation Lab.
RADIO PROPAGATION QUALITY IN THE NORTH ATLANTIC AREA 1953-1960
M. E. Nason *In* Agard, Paris The Effect of Disturbances of Solar Origin on Commun. 1963 p 287-291 (See N64-15426 07-08)

A study has been made of HF radio propagation disturbances, to determine the frequency of occurrence and the duration of disturbances on a monthly, seasonal, and yearly basis. The more severe disturbances, indicative of very poor or useless reception on the North Atlantic paths, have been treated separately. Graphs are presented for both types of disturbances that show the percentage of disturbed hours by months, seasons, and years. Author

N64-15450 RCA Communications, Inc., New York, N.Y.
CIRCUIT RELIABILITY, FREQUENCY UTILIZATION, AND FORECASTING IN THE HIGH FREQUENCY COMMUNICATION BAND
J. H. Nelson *In* Agard, Paris The Effect of Disturbances of Solar Origin on Commun. 1963 p 293-301 (See N64-15426 07-08)

This paper deals with high-frequency propagation with particular emphasis on circuit reliability, seasonal characteristics, frequency utilization, short-range and long-range forecasting of signal qualities and frequency requirements. All of these features are related to the maximum, minimum, and intermediate ranges of the 11-year sunspot cycle. The long-range forecasting of some recent (1960) magnetic storms associated with solar flares is treated with an explanation of the technique used for such a manner of forecasting. Author

N64-15470* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
RADIO AND OPTICAL SPACE COMMUNICATIONS
P. Potter, R. Stevens and W. Wells *In* AGARD, Paris Light and Heat Sensing 1963 p 235-262 refs (See N64-15452 07-23)
(NASA Contract NAS7-100)

In this report, the theory and state-of-the-art of laser sources is reviewed, and the possible application of these devices to space communications and long-range radar (or lidar) is discussed. Sample optical and radiofrequency systems are analyzed in detail. Practical system and component problems that arise in optical communication and lidar systems are discussed. Author

N64-15553* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
SPACE PROGRAMS SUMMARY NO. 37-24, VOLUME III FOR THE PERIOD SEPTEMBER 1, 1963 TO OCTOBER 31, 1963. DEEP SPACE INSTRUMENTATION FACILITY
30 Nov. 1963 107 p refs
(NASA Contract NAS7-100)
(NASA CR-55419; JPL SPS-37-24, vol. III)

The following areas of activity at the Deep Space Instrumentation Facility (DSIF) are discussed: (1) Goldstone operations; (2) engineering development—Mark I ranging subsystem, systems engineering, antenna engineering; (3) research and development—ground antennas, planetary radar project, lunar radar project, ranging and tracking system development, S-band implementation for DSIF, telemetry system development, RF signal generation and control, Mesa antenna range; and (4) advanced antenna systems. P.V.E.

N64-15686 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
AN ASTRO-SHIP CALLS THE EARTH; SUPER LONG-DISTANCE COMMUNICATIONS WITH A SPACE SHIP
V. A. Sokolov and Yu. F. Ivanov 27 Aug. 1962 17 p Transl. into ENGLISH from Nauka i Zhizn (Moscow), no. 2, 1962 p 13-19
(FTD-TT-62-721/1+2; AD 286611)

The necessary creation of new radio engineering and communications for use in interplanetary space is considered. For this purpose, testing of visible-color, infrared, and ultraviolet waves (the use of the "optical window" of the atmosphere) is indicated. Many projects using light in this manner are in progress, including the use of solar beams, and artificial light sources, such as the plasma cloud and lasers. R.L.K.

N64-15701 National Bureau of Standards, Boulder, Colo.
PRELIMINARY RESULTS OF UHF AIR-TO-GROUND PROPAGATION MEASUREMENTS
Albrecht P. Barsis Bedford, Mass., Electronics Systems Div., Jul. 1963 36 p refs
(AF Order 63-313)
(ESD-TDR-63-422; AD-417196)

A measurement program is being carried out of transmissions in the UHF band, which originate from airborne transmitters at a nominal altitude of 23,000 ft above east central Indiana. Several receiving stations within and slightly beyond the radio horizon are used. The data are being analyzed to show long- and short-term transmission-loss variations over these paths, including estimates of the effects of the flight pattern of the transmitting aircraft on the character of the received signal. Initial results show that long-term variability of basic transmission loss as measured by percentile ranges of hourly or daily medians is essentially in agreement with predictions. The absolute received signal levels, however, are mostly below free-space values for the distances concerned, necessitating detailed terrain analyses along the paths in order to arrive at an appropriate propagation model. The character of short-term fading at the various receiving sites depends quite markedly on the direction of the flight pattern axis. Author

N64-15734 Texas U., Austin Electrical Engineering Research Lab.
OBSERVATIONS AT AND NEAR VERTICAL INCIDENCE WITH AN M-33 RADAR
A. P. Deam, G. B. Walker, and A. H. La Grone 30 Nov. 1963 43 p refs
(Contract AF 19(604)-8038)
(Rept. 6-56; AFCRL-63-921; AD-429529)

This report includes the results of a brief observation period with an M-33 X-band radar. Data were obtained by pointing the radar in a fixed vertical position and by observing radar echoes, which were recorded on film, of tracks of invisible airborne targets. The report attempts to set limits of signal strength to be expected at the radar for various atmospheric phenomena and to establish a probability of seeing a particular type return. Author

N64-15737 Pennsylvania U., Philadelphia Moore School of Electrical Engineering
SPECTRUM SIGNATURE COLLECTION PLAN FOR GCA RADAR SYSTEM AM/CPN-4
R. Harper, D. Farmer, and W. Wydro (AEL) Griffiss AFB, N.Y., Rome Air Development Center, Jan. 1964 66 p refs
(Contract AF 30(602)-2888, Change A)
(RADC-TDR-63-517; AD-429889)

A study has been made of the AN/CPN-4 Radar System to specify methods of evaluating both its susceptibility to a source of interference and its characteristics as such a source. This is one of a class of new equipment being investigated to determine suitable methods for obtaining spectrum signatures. The final result of this study is the recommendation of a set of test procedures that would adequately evaluate the interference characteristics of this equipment. Recommendations are based upon Mil-Std-449B, whose test procedures are followed where they are applicable to the AN/CPN-4 Radar System.
Author

N64-15758 Lockheed Missiles and Space Co., Sunnyvale, Calif.
SPACE TELEVISION: AN ANNOTATED BIBLIOGRAPHY
Eugene E. Graziano, Comp. Mar. 1962 38 p refs
(Contract AF 04(647)-791)
(LMSC-3-79-61-1; SB-61-63; AD-296805)

This selective bibliography was compiled in support of research regarding television as a medium to obtain biomedical information by monitoring space travelers during flight. All aspects of space vehicle television systems, including recording, transmission, and ground reception, were of interest. The materials cited date from January 1959 to October 1961.
Author

N64-15792 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
SPACE PROGRAMS SUMMARY NO. 37-25, VOLUME III FOR THE PERIOD 1 NOVEMBER-31 DECEMBER 1963. THE DEEP SPACE INSTRUMENTATION FACILITY
31 Jan. 1964 66 p refs
(NASA Contract NAS7-100)
(NASA-CR-53065; JPL-SPS-37-25, Vol. 3) OTS: $6.60 ph, $2.18 mf

The DSIF is a precision tracking and data acquisition network that is designed to track, command, and receive data from deep-space probes. It utilizes large antennas, low-noise phase-lock receiving systems, and high-power transmitters at stations positioned approximately 120 deg around the earth. Research and development of new components and systems are conducted continuously to maintain a state-of-the-art capability.
Author

N64-15808 Florida U., Gainesville Engineering and Industrial Experiment Station
A THEORY OF QUANTUM COMMUNICATIONS Scientific Report No. 2
John B. O'Neal, Jr. 5 Dec. 1962 74 p refs
(Contract AF 19(628)-431)
(AFCRL-64-3; AD-429721)

A model is formulated for a band-limited quantum communications channel and the channel capacity in the absence of external and thermal noise. Taken into consideration is the fact that quantization limits the ability of the signal to contain information, and that every band-limited signal contains an irreducible uncertainty that degrades channel performance. Bounds for the capacity of a band-limited quantum channel in the absence of external or thermal noise are found. The upper bound is derived from a procedure commonly used in statistical mechanics. The lower bound is derived using the Gaussian approximation of a Poisson distribution. It is shown how the quantum channel model formulated lends itself to analyses that include the effects of external and thermal noise.
C.L.W.

N64-15818 Pennsylvania U., Philadelphia Moore School of Electrical Engineering
STUDY AND INVESTIGATION OF POLARIZATION PROGRAMMING. VOLUME II: POLARIZATION SYSTEMS ANALYSIS
R. S. Berkowitz, J. Choder, P. M. Hahn, R. G. Mulholland, and R. F. Schwartz Griffiss AFB, N.Y., RADC, Jan. 1964 72 p refs Work performed under subcontract from Am. Electron. Labs.
(Contract AF 30(602)-3105)
(Moore School Rept. 64-02; RADC-TDR-63-396, Vol. 2; AD-430249)

The choice of frequency range based upon preservation of polarization is discussed, and a few factors that can lead to depolarization at higher frequencies are mentioned. A somewhat detailed discussion is given of the polarization effects that take place in propagation via the ionosphere, with some emphasis on future applications to satellite communication. The troposcatter propagation factors affecting a polarization programing system are presented. A general mathematical description of polarized waves of all types and of their transmission channel is given. The discussion includes antenna considerations. It is concluded that the application of polarization programing to an over-the-horizon troposcatter link seems to be feasible, and that with all factors considered it should lie in the range of 1 to 10 kmc.
Author

N64-15825 Aerospace Corp., El Segundo, Calif. Engineering Div.
MINIMUM SIGNAL TO NOISE-DENSITY RATIOS FOR TRANSMISSION OF TELETYPE AND SPEECH
F. F. Yates Jan. 1964 12 p refs
(Contract AF 04(695)-269)
(SSD-TDR-63-215; TDR-269(4111)-7; AD-429202)

The signal-to-noise requirements of a phase-modulation communication channel are considered for the transmission of teletype and voice for certain specified performance criteria. Three typical communication services are analyzed: (1) 100 wpm teletype, 1/20 letter error rate; (2) 3 kc voice, 80% word intelligibility; (3) 3 kc voice, 30 db output base band signal-to-noise ratio (measured for a sinusoidal test tone). The transmission requirements are expressed in terms of the minimum signal-to-noise-density ratio $(P_s/n)_{min}$ required in the predetection bandwidth (B_n) of the signal demodulator. The results are summarized.
Author

N64-15830 Joint Publications Research Service, Washington, D.C.
PARAMAGNETIC AMPLIFIER FOR A PLANETARY RADAR
M. Ye. Zhabotinskiy and A. V. Frantsesson 29 Feb. 1964 8 p refs Transl. into ENGLISH from Radiotekhn. i Elektron. (Moscow), v. 9, no. 1, Jan. 1964 p 114–117
(JPRS-23468; OTS-63-21689) OTS: $0.50

A paramagnetic amplifier was developed for a planetary radar receiver in which a ruby with a chrome concentration of 0.017% was used as the paramagnetic substance. The amplifier was tested, and it was apparent that the absolute value of the magnetic quality of the paramagnetic substance changed in proportion to the temperature, from 1.7° to 4.2° K. With a

chrome ion concentration of 0.017% at a frequency of 700 mc, the harmful action of the cross-relaxation does not appear; thus the concentration may be increased. The paramagnetic amplifier was utilized sucessfully in radar contact with the planets Mercury and Venus and in radiotelegraphic communication with the planet Venus. C.L.W.

N64-15926 Kyoto U. (Japan)
MICROWAVE TECHNIQUE ON PISTON MOTION MEASUREMENT IN HYPERSONIC GUN TUNNEL
Goro Kamimoto, Toshikazu Mori, Takeyoshi Kimura, and Kuniaki Kawachi Nov. 1963 24 p refs
(CP.-4)

In order to measure the piston path in the gun-tunnel barrel, a microwave technique was adopted. Because displacement is recorded continuously, this technique permits analysis of the piston oscillation in detail. The effects of various factors, especially of open barrel end on the piston oscillation are described. As to initial piston track, the experimental results are compared with the theoretical piston trajectory. Author

N64-15941 Harvard U., Cambridge, Mass. Cruft Lab.
A STUDY OF THE SLOT TRANSMISSION-LINE AND SLOT ANTENNA. PART 2: A COAXIAL AMPLITUDE-INSENSITIVE PHASE-DETECTION SYSTEM
Robert W. Burton 20 Jan. 1963 14 p refs
(Contract Nonr-1866(32))
(TR-398; AD-401892)

A coaxial amplitude-insensitive phase-detection system is discussed in detail. The system employs the hybrid junction in a balanced detector configuration to render a null reading independent of the relative magnitudes of both the reference and the unknown signals. A theoretical formulation, experimental results, and evaluation of errors are presented. Author

N64-16107* Massachusetts Inst. of Tech., Cambridge Research Lab. of Electronics
A 22-Gc BALANCED CANONICALLY TUNED VARACTOR QUADRUPLER WITH 50-mw OUTPUT POWER
R. P. Rafuse and D. H. Steinbrecher [1964] 5 p refs Presented at the Intern. Solid State Circuits Conf., Philadelphia, 19–21 Feb. 1964
(NASA Grant NsG-419)
(NASA CR-55223) OTS: $1.10 ph, $0.80 mf

The varactor multiplier is believed to be the first successful realization of a symmetric, multiple-diode varactor frequency multiplier at centimeter wavelengths. The quadrupler is capable of delivering a power output of more than 50 mw at 22 gc, with an efficiency in excess of 13%. The circuit is unique in several respects. The breadboard model of the quadrupler is described as follows: The coaxial structures serve as the idler tuning adjustments, while simultaneously providing short circuits at the guide faces, independent of the position of the idler tuning stubs. The third harmonic (16.65 gc) is open circuited at the input port by a quarter-wave series trap. The output is tuned and matched to the load with a sliding backshort and an E-H tuner, and additionally filtered with a simple cavity filter to insure that all the indicated output power is at 22.2 gc. Input tuning is provided by coaxial, double-stub tuners. The diodes are individually biased from 1,000 Ω ten-turn potentiometers supplied with 12 volts. I.v.L.

N64-16110* Alabama U. Research Inst., Huntsville
WAVEGUIDE WITH ARBITRARY CROSS-SECTION CONSIDERED BY CONFORMAL MAPPING
F. J. Tischer and H. Y. Yee Jan. 1964 22 p refs
(NASA Grant NsG-381)
(NASA CR-55509; UARI-RR-12) OTS: $2.60 ph, $0.86 mf

The arbitrarily shaped waveguide is transformed by conformal mapping into a rectangular guide filled with a hypothetical medium. The permittivity and the permeability are anisotropic with the longitudinal component dependent on the transverse position. The field distributions and the propagation characteristics are computed for the transformed guide for both TE and TM modes. The field distributions in the original waveguide can be obtained by inverse transformation. An iterative approximation method is used for deriving a solution of the nonseparable wave equation. As an example, the properties of a coaxial guide are considered by this method and the results compared with known data. Author

09 ELECTRONICS

Includes circuits and circuit theory; electronic components (e.g., tunnel diodes, transistors, and tubes); and feedback and control theory. *For related information see:* 06 Auxiliary Systems; 08 Communications; 15 Instrumentation and Photography; 22 Navigation and Guidance; and 25 Physics, Solid-State.

N64-15032 Deutsche Versuchsanstalt für Luft- und Raumfahrt, Oberpfaffenhofen, (W. Germany) Inst. für Flugfunk und Mikrowellen
BINARY EFFECTS OF COUPLED LINEAR FEEDBACK SHIFT-REGISTER, GENERATION, CHARACTERISTICS AND EXAMPLES OF APPLICATION [BINARFOLGEN LINEAR RUCKGEKOPPELTER SCHIEBEREGISTER, ERZEUGUNG, EIGENSCHAFTEN UND ANWENDUNGSBEISPIELE]
Horst H. Leibelt Nov. 1963 89 p refs In GERMAN Available from Vereinigte Universitäts- u. Fachbuchhandlungen, R. Wagner Str. 1, Cologne, W. Germany
(DVL-307)

The characteristics of the binary effects generated by a coupled-feedback linear shift register are discussed. Emphasis is placed on investigations of period length, the correlation function, and the number of effects with maximum-period length. Trans. by I.v.L.

N64-15054 Electro-Mechanics Co., Austin, Tex.
AN ELECTRONIC SYSTEM FOR ANALYZING VARIABLE-AREA MAGNETOGRAMS Final Engineering Report No. 2, 1 Mar. 1960-30 Apr. 1963
R. L. Waters, F. C. Tormolian, F. J. Morris, and E. J. Chernosky (AFCRL) 30 May 1963 20 p
(Contract AF 19(604)-5520)
(AFCRL-63-939(2); AD-428879)

A method was developed to record variations in the earth's field giving a variable-area record instead of the conventional line trace. The recording device is the Magnetovariograph. A suitable analyzer was required to provide the detailed magnetic field information available from those magnetograms. A photoelectric sweep scanner and an electronic analyzer, which provided conversion of data to digital form and summation of value over a series of scans, were designed to meet the requirements. The data output of the scanner are converted in the analyzer to clock pulses, a 10 msec scan time corresponding to 1000 counts. Difference between successive scans is obtained by subtractor circuits and later averaged to give rates of change. Results from both summing and

subtracting circuits are punched in decimal form on IBM cards. The characteristics and design of the analyzer are briefly described, and the methods and conclusions of tests of the entire system are discussed. Author

N64-15057 Bendix Corp., Southfield, Mich. Research Labs. Div.
INVESTIGATION OF TECHNIQUES FOR SPACE-ORIENTED TUBES Interim Report
John G. Meeker Griffiss AFB, N.Y., Rome Air Develop. Center Jan. 1964 132 p refs
(Contract AF 30(602)-2984)
(RADC-TDR-64-7; AD-428601)

The primary goal of this study is to establish criteria for the design of high-power microwave amplifiers and for the selection of their constituent materials that will adequately allow the tubes to perform their functions in the environmental conditions associated with space missions. Most of the ceramics and metal materials currently used in the construction of microwave amplifiers are suitable for space operation. Preflight testing as well as basic design considerations are also included in this report. Author

N64-15058 Compagnie Générale de Télégraphie sans Fil, Paris (France)
GENERATION OF INFRAMILLIMETRIC WAVES BY MEANS OF ELECTRONIC BEAMS Technical Note No. 1
Yeou Ta 31 Oct. 1963 6 p refs
(Contract AF 61(052)-715)
(RADC-TDR-64-29; AD-428576)

High-frequency waves over the range of 541 to 612 Gc/s have been obtained by a recent CSF 0.5-mm carcinotron at the milliwatt level. Author

N64-15059 Centre de Physique Electronique et Corpusculaire, Orsay (France)
GENERATION OF INFRAMILLIMETRIC WAVES BY MEANS OF ELECTRONIC BEAMS Interim Technical Report No. 1, 1 Jul. 1963-30 Sep. 1963
Yeou Ta 1963 8 p
(Contract AF 61(052)-715)
(RADC-TDR-64-44; AD-428778)

Design considerations for O-type carcinotrons for generating submillimeter waves are given, and details of construction and operation of a 0.5-mm tube are discussed. E.W.

N64-15060 Centre de Physique Electronique et Corpusculaire, Orsay (France)
GENERATION OF INFRAMILLIMETRIC WAVES BY MEANS OF ELECTRONIC BEAMS Interim Technical Report No. 2, 1 Oct. 1963-31 Dec. 1963
Yeou Ta 1963 8 p
(Contract AF 61(052)-715)
(RADC-TDR-64-45; AD-428777)

Testing and machining of two 0.4-mm carcinotron tubes are discussed. The testing of the first tube was conducted by the generation of inframillimetric waves with an electronic beam operated in a continuous wave for undersurface measurements. The machining for the second tube consisted of line construction and the mounting of an electronic gun in order to create a greater current density. A.L.B.

N64-15061 Watkins-Johnson Co., Palo Alto, Calif.
APPLIED RESEARCH ON A HIGH-POWER MILLIMETER-WAVE GENERATOR Final Report, Jun. 1961-Aug. 1963
J. W. Sedin, M. Purnell, and K. W. Slocum Wright-Patterson AFB, Ohio, Electronic Technol. Div., Aug. 1963 158 p refs
(Contract AF 33(616)-8369)
(W-J 63-435R35; RTD-TDR-63-4174; AD-428241)

The purpose of this program is to demonstrate the feasibility of generating very high power, specifically, 100 kw peak and 1000 w average at 100 Gc, by means of an O-type backward-wave oscillator operating at very high voltage. A disc-loaded waveguide, which operates from 90 kv to 200 kv, was selected as the circuit for the backward wave oscillator. A 900 to 1 convergence-ratio electron gun was developed. This perveance 0.126×10^{-6} electron gun was focused through a 0.62-in.-diam. beam hole with over 96-percent transmission at 190 kv. The power density in the beam was 280 mw per cm^2. Peak power of 107 kw was measured using a calorimeter as a power standard. An average power of 324 w was measured using the calorimeter. Both of these power levels exceed any other known values of power at a frequency of 100 Gc. Author

N64-15074 IIT Research Inst., Chicago, Ill.
STUDY OF COMPREHENSIVE FAILURE MECHANISM THEORY Final Report, 26 Feb. 1962-26 May 1963
M. E. Goldberg, A. Horberg, D. W. Levinson, and R. G. Stewart Griffiss AFB, N.Y., Rome Air Develop. Center, Aug. 1963 90 p refs
(Contract AF 30(602)-2731)
(RADC-TDR-63-431; AD-426733)

A deposited film resistor was selected as the part to be studied for developing a comprehensive failure mechanisms theory. Changes in resistance as functions of time and temperature are the failure mode and stress, respectively, receiving initial consideration. The resistive film, formed from deposition of Evanohm (75% Ni, 20% Cr, 2.5% Al, 2.5% Cu) onto the resistor substrate, can be expected to be richer in Al, Cu, and Cr than the alloy itself. As a result, behavior of the resistive film will differ from that which can be predicted from the characteristics of the alloy. Furthermore, composition may be expected to change over the entire evaporation cycle leading to significant differences in the composition of the resistive film between ostensibly identical resistors. Oxidation appears most likely to be the mechanism responsible for observed increase in resistance with time, at elevated temperature. Author

N64-15077 University of Southern Calif., Los Angeles Engineering Center
RADIATION FROM A PLASMA-CLAD AXIALLY-SLOTTED CYLINDER
W. V. T. Rusch May 1962 55 p refs
(Contract AF 19(604)-6195)
(USCEC-82-201; AFCRL-714; AD-278146)

Expressions have been developed for the complete radiation pattern from a finite axial slot on an infinite circular cylinder covered with a homogeneous, uniform plasma sheath. The resulting field expressions are functions of both the longitude angle, ϕ, and the polar angle, θ. Numerical results have been obtained for a thin lossless plasma to determine the variation of the field pattern with plasma frequency, plasma thickness, slot width, and cylinder radius. These results are presented graphically to illustrate various properties of the radiating system. Author

N64-15079 Teledyne Systems Corp., Hawthorne, Calif.
UNFURLABLE ANTENNA TECHNIQUES FOR HIGH-GAIN APPLICATIONS Final Report, Jun. 1962-Aug. 1963

J. C. Polk 1 Oct. 1963 118 p refs
(Contract AF 33(657)-8709)
(TSC-63-ESL-21; RTD-TDR-63-4093; AD-426230)

CONTENTS:
1. SELF-RIGIDIZING UNFURLABLE ANTENNA SYSTEM Willis Paul (Schjeldahl (G.T.) Co.) 40 p refs (See N64-15080 07-09)

N64-15080 Schjeldahl (G. T.) Co., Northfield, Minn.
SELF-RIGIDIZING UNFURLABLE ANTENNA SYSTEM Final Report
Willis Paul 5 Aug. 1963 *In* Teledyne Systems Corp. Unfurlable Antenna Tech. for High-Gain Appl. 1 Oct. 1963 40 p refs (See N64-15079 07-09)

The objective of this work was to develop pressure-erection and rigidizing techniques for unfurling broad-beam circularly polarized antenna elements and supporting structures in a space environment. Theoretical studies were conducted to determine expected operating temperatures and the magnitude of forces acting on the structure. The results of these studies, in conjunction with a detailed structural analysis, served to establish the strength and rigidity requirements of the system. Numerous rigidization methods were tested analytically or empirically to determine which would best meet these requirements. These studies showed that three methods were feasible: Mylar–aluminum-foil laminates rigidized by the inflation process; ultraviolet-rigidized resin; and ultraviolet-foamed resin. Specimens rigidized by each of the three methods were tested to ensure that all strength, rigidity, and temperature requirements were satisfied. Author

N64-15096 Naval Postgraduate School, Monterey, Calif.
TRANSISTOR ELECTRONICS
Abraham Sheingold Apr. 1963 53 p
(*Its* Res. Paper-35; AD-429421)

A general discussion of transistor electronics is presented in which the following topics are discussed in particular: (1) transistor action; (2) the transistor as a circuit element; (3) total current–voltage relations—the common-emitter model, complete resistive models, graphical analysis of a transistor amplifier; (4) biasing circuits and operating-point stabilization—bias circuit arrangements; and (5) transistor linear amplifiers—amplifier performance factors, transistor parameters, common-base and common-emitter amplifier characteristics, common-collector amplifier. P.V.E.

N64-15114 Naval Ordnance Lab., White Oak, Md.
SOLID STATE MICROWAVE AMPLIFIERS
Edward T. Hooper, Jr. In ONR Solution to Navy Probl. through Advanced Technol. [1963] p 189–205 refs (See N64-15101 07-01) OTS: $5.00

Amplifiers are classified according to their local power and the agent employed. In the first group described, the agent is free, i.e., it has translational energy of motion and, as a consequence, is excited by direct local power. In the second group, the agent is bound or constrained and is excited by alternating local power. Amplifiers using alternating local power are discussed in detail. Of this type, the solid-state parametric diode and parametric magnetic amplifiers are the principal contenders for a solution of the microwave amplifier problem. The operating principles of solid-state parametric amplifiers are discussed. The general theory of parametric pumping is applied to the case of the ferromagnetic microwave amplifier in an effort to reduce the noise. R.T.K.

N64-15126 Raytheon Co., Waltham, Mass.
HIGH FREQUENCY TUNNEL DEVICE STUDY Final Technical Report
S. R. Steele, W. Feist, J. Levine, and J. Oberly Jun. 1963 93 p refs
(Contract AF 30(602)-2673)
(RADC-TDR-63-321; AD-428077)

The specific objective of this program has been to investigate methods of achieving low-noise amplification at microwave frequencies utilizing tunneling through thin films. The design goals were 20-db gain, 6-db noise figure at 10 kMc, with a 1 kMc bandwidth. Two alternate approaches to achievement of these goals were investigated as concurrent phases. Phase I was aimed at attaining the requisite amplification using an all solid-state device; whereas Phase II was directed towards utilizing a thin film cathode in conjunction with a microwave structure. The design goals were not attained by the end of the program, but the relative feasibility of the approaches was demonstrated. It was determined that the tunnel cathode is promising for its application. Author

N64-15127 Naval Research Lab., Washington, D.C.
A THEORETICAL ERROR ANALYSIS OF THE U.S. NAVAL SPACE SURVEILLANCE SYSTEM
W. B. Gordon and J. W. Wood 4 Jan. 1963 35 p refs
(NRL-5864; AD-295606)

This report is a theoretical study of the errors due to random noise to be expected in the measurements of satellite position, velocity, and other orbital parameters. Both phase and phase-rate data are considered with a view toward the following applications: (1) weighting data from satellite passes received at several stations to produce better estimates of both position and velocity; (2) improving first pass capability to determine orbital parameters; and (3) providing real-time designation data for tracking systems. Results are displayed as equal error contours on vertical plots of the Spasur fence for basic position and velocity components. Author

N64-15249 Sandia Corp., Albuquerque, N. Mex.
PREPARATION OF RESISTORS USING A LOW-TEMPERATURE-COEFFICIENT-OF-RESISTANCE ELECTROLYTE
R. D. Kelly (N. Mex. U.) Jan. 1964 147 p refs
(Supported by AEC)
(SC-4794(RR)) OTS: $2.50

An electrolytic solution containing acid, sugar, salt, and distilled water (boric acid, mannitol, and potassium chloride) was experimentally tested to determine its suitability for use in preparing "water resistors" that exhibit a low temperature coefficient of resistance throughout the range from 40° F to 160° F. The resistors use standard plastic containers provided with suitable end electrodes for containing the solutions. A scheme is presented for determining the amounts of the various electrolyte constituents to obtain any resistance value throughout the range from 10 K ohms to 100 K ohms. The resulting resistors exhibit excellent temperature characteristics from 60° to 160° F, and acceptable characteristics down to a temperature of 40° F. Author

N64-15265 Watkins-Johnson Co., Palo Alto, Calif. Systems Div.
A 2.5 WATT X-BAND TRAVELING-WAVE TUBE AMPLIFIER FOR SATELLITE APPLICATIONS
R. E. Pospisil *In* AF Systems Command Trans. of the 8th Symp. on Ballistic Missile and Space Technol., Vol. 2 [1963] p 335–368 refs (See N64-15251 07-01)
(Contract DA 36-039-AMC-00093(E))

This paper describes a high-efficiency, high-reliability, 2.5-watt, X-band amplifier, which is designed specifically for long-life satellite environments. The amplifier is an integration of the latest state-of-the-art advances in both microwave and solid-state circuitry. The total program encompasses a thorough analytical study, design, development, production, and subsequent life testing of 63 amplifiers. Author

N64-15308* Princeton U., N.J.
GAS-TRIGGERED INVERSE PINCH SWITCH
R. G. Jahn, W. von Jaskowsky, and A. J. Casini Repr. from Rev. Sci. Instr., v. 34, no. 12, Dec. 1963 p 1439–1440
(NASA Grant NsG-306-63)

A description is presented of modifications applied to an inverse pinch, triggered gap switch in converting it to gas-triggered operation. The switch in the modified form is used to provide low inductance, low-noise switching of a 15μF, 10-kv capacitor bank, over extended periods of service. P.V.E.

N64-15316 Radio Corp. of America, Patrick AFB, Fla.
THE GLOTRAC SYSTEM
J. W. Stephenson Jr., and R. K. Weller *In* AF Missile Test Center New Data Reduction Methods to Improve Range Data. [1963] p 111–120 (See N64-15312 07-01)

The GLOTRAC System is described, together with its geographical configuration. The types of electronic equipment involved are given in detail. The system is described mathematically; its measurements are defined, and the anticipated significant error sources are discussed. A detailed description of mathematical formulation to be used in processing the GLOTRAC data is presented. The application of the method of maximum likelihood adjustment to the processing is briefly examined. Author

N64-15320 General Electric Co., Philadelphia, Pa. Missile and Space Div.
APPLICATIONS OF DIGITAL FILTERING TECHNIQUES TO DATA PROCESSING
Marcel A. Martin *In* AF Missile Test Center New Data Reduction Methods to Improve Range Data [1963] p 197–223 ref (See N64-15312 07-01)

Interpretation of digital filters as linear transducers characterized by their transfer functions leads to practical methods for specifying filters and evaluating their performance. Applications of the theory to filters used in smoothing, differentiation, interpolation, and power spectrum analysis of sampled data are discussed. Classical methods, such as polynomial least square fit and Lagrange interpolation formula, are evaluated as particular cases of filtering techniques. The quality of the information provided by filters designed from frequency domain considerations and precautions that must be taken in the use of these filters are pointed out. Author

N64-15369 General Electric Co., Syracuse, N.Y.
PRODUCTION ENGINEERING MEASURE FOR THE MANUFACTURE OF DEFLECTRON DEVICES Third Quarterly Progress Report, 14 Nov. 1962-14 Feb. 1963
W. J. Noroski, Jr. [1963] 32 p
(Contract DA-36-039-SC-86731)
(AD-403324)

A redesign of the basic master for the CY1.1-33° has been satisfactorily completed. Ceramic substrate cones for the model Deflectron were put in process. A study for determining a technique for fastening electrode pins in the ceramic cones was initiated and completed. The adaptation of the vacuum-metallizing technique for manufacturing Deflectron units continues. Author

N64-15377 Goodyear Aircraft Corp., Akron, Ohio
ADVANCED ANTENNA DESIGN TECHNIQUES Third Quarterly Progress Report, 16 Dec. 1962-28 Feb. 1963
D. D. Collins and J. C. Bell, Jr. 28 Mar. 1963 101 p refs
(Contract DA-36-039-SC-90746)
(GER-11045; AD-404783)

The rigid-panel Swirlabola space-vehicle antenna, the AIRMAT paraboloid ground-based antenna, and the lenticular AIRMAT ground-based antenna are studied and analyzed. Detail design configurations for models of these three antennas are established. Author

N64-15498 Watkins-Johnson Co., Palo Alto, Calif.
DEVELOPMENT OF AN E-BAND AMPLIFIER Technical Note
E. W. Kinaman Nov. 1963 55 p
(Contract AF 30(602)-2422)
(RADC-TDR-63-505; AD-427819)

This report describes the research and development toward establishing the feasibility of building a low-noise tunable amplifier equipment for E-band. The approach describes development of a traveling-wave amplifier and an yttrium-iron-garnet filter for tandem operation. The major subassembly problems were solved, and measurements were made of 5-db tube gain and 1.6-db filter loss near 80 Gc. Tubes with 13- to 16-db noise figure and gain of 20 ±5 from 69 to 96 Gc have been evaluated. Author

N64-15519 Air Force Cambridge Research Labs., Bedford, Mass.
LINE SOURCE ANTENNA ARRAYS FOR CONTROL OF PATTERN, DISPERSION, AND PHASE
C. J. Sletten, P. Blacksmith, Jr., F. S. Holt, and J. E. Holland Jun. 1963 39 p refs
(AFCRL-63-182; AD-413410)

A method of beam synthesis using a superposition of elemental plane waves is applied to problems of microwave antenna patterns of general shape. The method is extended to the limit of an infinite number of plane waves and related to usual Fourier transform methods. A linear array and a lens horn for generating a "rectangular-shaped" beam are designed and experimental results are given. Several new types of microwave prisms are designed for practical waveguide feeding and their performance analyzed. These prismatic antennas allow control of array dispersion, that is, beam swing with frequency change. Techniques for both maximizing and minimizing dispersions are presented. An analytic procedure for describing a curved reflecting surface to produce an arbitrary phase distribution along a line aperture is presented. Author

N64-15547* General Dynamics/Astronautics, San Diego, Calif.
STUDY OF RADIO TELESCOPE IN ORBIT (RATIO) STRUCTURES Quarterly Report No. 2, 15 Aug.-15 Nov. 1963
J. R. Lloyd, G. H. Nowak, and P. Slysh 27 Nov. 1963 63 p refs
(Contract NAS7-228)
(NASA CR-55669) OTS: $6.60 ph, $2.09 mf

The topics discussed include: (1) radiation pattern—far-field representation, phase function, unit vectors $\bar{n}$ and $\bar{s}$, normalized radiation intensity, numerical integration, and computation procedure; (2) structural loads—geometry of structure, reaction loads, flywheel and antenna turning rates, model functions for

antenna turning rates, applied torques, inertia of dish, and reaction feed forces; (3) thermal distortion; and (4) structural analysis—stiffness determination, method of analysis, thermal loading, loads not applied at the joints, and members with nonuniform properties. R.T.K.

N64-15625* General Motors Corp., Indianapolis, Ind. Allison Div.
DEVELOPMENT AND TESTING OF ELECTROLYTE MATRIX COMBINATIONS FOR MERCURY-POTASSIUM FUEL CELL Quarterly Technical Progress Report No. 1, 12 Dec. 1962-12 Mar. 1963
H. R. Karas and J. D. Mangus *In its* Res. and Develop. of an Advanced Lab. Liquid Metal Regenerative Fuel Cell 28 May 1963 33 p refs (See N64-15624 07-06)
(NASA Contract NASw-476)
(EDR-3344)

An investigation is being made of the use of an unconsolidated ceramic-electrolyte composite matrix. Progress is reported in the following areas: (1) small differential density cell-resistivity cell studies; (2) conductivity measurements of coarse-grain composites; (3) strength measurements of coarse-grain composites; (4) the development of a technique for preparing fine-grain composites; and (5) the design of a small liquid-metal cell and test rig. I.v.L.

N64-15685 Motorola Inc., Scottsdale, Ariz. Military Electronics Div.
INVESTIGATION OF THE STABILIZATION OF PARAMETRIC AMPLIFIERS Final Report
D. E. Allen and R. B. Butterton 5 Dec. 1963 65 p
(Contract AF 19(628)-433)
(AFCRL-63-573; AD-429159)

A summary of the basic theory of parametric amplifiers is given with emphasis on the degenerate mode of operation as applied to receiver front ends for microwave radiometry. The development of a 15.5 Gc amplifier is described. This amplifier utilizes gain stability by feedback of a reference noise level to control the pump power. The amplifier has 17-db gain, 70-Mc bandwidth, and 3.0-db noise figure. The utilization of feedback results in a 15 to 1 improvement of gain stability for pump power changes. A 1.0 Gc degenerate mode amplifier for use as the first stage of a radiometer IF amplifier is developed. The amplifier has a 98 Mc bandwidth at 17 db gain, and a 1.0 db noise figure. A gain stabilization technique similar to that used on the 15.5 Gc amplifier results in a 10 to 1 improvement of gain stability for pump power changes. Author

N64-15705 Union Carbide Corp., Parma, Ohio Linde Div.
DEVELOPMENT OF THIN ORGANIC ROLLED FILM CAPACITOR Second Quarterly Progress Report, 1 Oct.-31 Dec. 1963
D. J. Valley [1963] 33 p
(Contract NObsr-89519)
(AD-429916)

The first phase of a study to improve the surface of the aluminum substrate was initiated. The areas in which active work has been done include surface decontamination, mechanical smoothing, and electrochemical polishing. Evaluation was begun on coated aluminum foils, and coated foils have been slit to 1/4, 1/2, 3/4, 1 1/4, and 1 1/2 inches from 1-inch or 2-inch stock. The capacitors rolled from the slit foils exhibited the same electrical properties and failure rates as capacitors rolled from 1-inch-wide unslit stock when the slit edges were placed in the margin of the roll. The termination of the capacitor rolls by flame spraying and soldering was not considered adequate. The capacitors were hermetically sealed in nickel–silver cans. The main objective of the life testing during the reporting period was to evaluate many material, design, and processing parameters, rather than to establish the failure rate of a large number of capacitors of similar genesis. A summary of average electrical values of the sample capacitors is included. R.T.K.

N64-15725 Polytechnic Inst. of Brooklyn, N.Y.
A NEW THEORY OF BROADBAND MATCHING
D. C. Youla Griffiss AFB, N.Y., Intelligence Appl. Branch. Jan. 1964 63 p refs
(Contract AF 30(602)-2213; Contract AF 30(602)-2868)
(RADC-TDR-63-512; Secondary Rept. to PIBMRI-1172-63; AD-429933)

A new broadband matching theory based on the principle of complex normalization is developed that completely circumvents the objections to the complications of applying the elegant Fano theory. Nontrivial, fully worked examples are included. The restrictions in power gain are expressed in both integral and nonintegral form. Author

N64-15786* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
EXCITATION OF HIGHER ORDER MODES BY A STEP DISCONTINUITY OF A CIRCULAR WAVEGUIDE
Cavour Yeh 1 Feb. 1964 17 p refs
(NASA Contract NAS7-100)
(NASA CR-53062; JPL-TR-32-496) OTS: $1.60 ph, $0.80 mf

The problem of excitation of higher order modes by a step discontinuity in a circular waveguide with an incident dominant H_{11} mode is considered. An approximate method is used to solve this problem. In this method, it is assumed that the tangential electric field at the discontinuity is zero everywhere except in the aperture where it is equal to the incident tangential electric field. Relative amplitudes of these excited modes are given and discussed. Author

N64-15806 Case Inst. of Tech., Cleveland, Ohio
MULTIPORT VOLTAGE TRANSFER FUNCTION Scientific Report No. 3
Togan Zeren (Ph.D. Thesis) Oct. 1963 106 p refs
(Contract AF 19(628)-1699)
(AFCRL-63-592; AD-430288)

After a review of existing work on the transfer function of two-port networks, two new methods of realization for these transfer functions are developed. These methods are based on splitting the denominator by means of even part and Bott–Duffin splitting techniques. The latter split is applicable to cases with or without imaginary axis poles. Next the multiport voltage transfer-function matrix is introduced, and the different structures of multiport networks are described. The necessary and sufficient conditions for realizability of the transformerless multiport-network transfer functions for the different structures are stated and proved. Author

N64-15822 Litton Systems, Inc., Silver Spring, Md. RADCOM-Advanced Technol. Div.
FREQUENCY TUNING BY PARAMAGNETIC RESONANCE
Griffiss AFB, N.Y., RADC, Dec. 1963 22 p
(Contract AF 30(602)-2938)
(RADC-TDR-63-526; AD-429814)

Studies have continued on the construction of a tunable filter employing nuclear magnetic resonance. Based on earlier experimentation, an induction head was designed and built

to stringent specifications. Tests have continued, using this head and an earlier model. A nuclear polarization experiment, using electron spin resonance at microwave frequencies, has been set up, and enhancement of the nuclear resonance signal has been observed. Author

N64-15857 Fairchild Semiconductor Corp., Mountain View, Calif.
PRODUCTION ENGINEERING MEASURE 2N914 AND 2N995 [TRANSISTORS] VOLUME I Final Report, 1 May 1962-31 Oct. 1963
P. M. Weiler [1963] 240 p refs
(Contract DA-36-039-SC-86726)
(AD-422641)

Efforts were made to improve production techniques in order to increase the reliability of silicon, planar, epitaxial transistors. A metal system was found to replace the aluminum–gold pattern metal system; small-ball bonding was investigated; a wire study was conducted; ultrasonic bonding was investigated; and dynamic and step tests were conducted on transistor devices. C.L.W.

N64-15878* General Electric Co., Philadelphia, Pa.
FIRST QUARTERLY REPORT OF STUDY OF CAPACITORS FOR STATIC INVERTERS AND CONVERTERS, AUGUST 16-NOVEMBER 16, 1963
J. F. Scoville 1963 15 p refs
(NASA Contract NAS3-2788)
(NASA CR-55745; R63SCW-31-1) OTS: $1.60 ph, $0.80 mf

This report contains: (1) an analysis of the operation of commutating capacitors; (2) selection of capacitance values to conduct a state-of-the-art survey; and (3) engineering specifications for capacitors for the survey. Author

N64-16039 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
HIGH POWER ELECTRONICS
P. L. Kapitsa (Acad. of Sci., USSR) 5 Sep. 1963 172 p refs
Transl. into ENGLISH from Usp. Fiz. Nauk (Moscow), v. 78, no. 2, 1962 p 181–265
(FTD-TT-63-253/1+2; AD-423231)

The following subjects are discussed in regard to high-power electronics: (1) Solution of the Fundamental Equation of Motion of Charged Particles by the Method of Time Averaging; (2) The Motion of Electrons in a Planotron (plane magnetron); (3) Basic Performance of the Planotron; (4) Anode and Cathode Losses in a Planotron; (5) The D Edge Effect and the Losses Connected with It; (6) Theory of the Magnetron; (7) Experimental Investigation of the Electron Processes in a Planotron; (8) The Larmor Orbit in a High-Frequency Field; and (9) Prospects of High-Power Electronics. P.V.E.

N64-16057 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
STEADY-STATE REGIMES OF A SYNCHRONOUS GENERATOR WITH IONIC SELF-EXCITATION
Sh. I. Lytudze and O. K. Maglaperidze 17 Oct. 1962 16 p refs
Transl. into ENGLISH from Electronenergetika (USSR), Issue 2, 1960 p 94–104
(FTD-TT-62-1043/1+2+4; AD-292192)

The steady-state regimes of a synchronous generator with ionic self-excitation were investigated. Results are: (1) The value of the commutation angle (when the parameters of the self-excitation system are given) varies only as a function of the control angle in the static regimes of operation. (2) An equation is given for the fulfillment of the necessary condition for the operation of the ionic self-excitation system of the generator. This equation relates all of the parameters of the self-excitation system. (3) The law of change in the control angle can be determined as a function of the load in the static regime, and the static characteristics of the generator can be plotted if the law of change in the generator voltage and the no-load and nominal load characteristics of the generator are known. (4) The automatic excitation regulator and the entire grid-control system must be designed so as to ensure the law and range of change in the control angle. I.v.L

N64-16071 Ohio State U. Research Foundation, Columbus Antenna Lab.
RESEARCH ON TECHNIQUES FOR INTEGRATION OF ACTIVE ELEMENTS INTO ANTENNAS AND ANTENNA STRUCTURE Interim Engineering Report, 1 Sep.-30 Nov. 1963
J. F. Rippin, Jr. 1 Dec. 1963 13 p refs
(Contract AF 33(657)-10386)
(Rept. 1566-7; AD-426682)

A Pi-network phase shifter that shows a phase shift range in excess of 90° at 148 mc is presented. Varactors are used as the controlled elements. A remotely tuned transistor amplifier that has been integrated into a conical spiral antenna is described, and the integration of a slot antenna with a transistor amplifier is discussed. Measurements of gain and phase shift for the transistorized dipole antennafier are also presented. Author

10 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands and wind tunnels); test ranges; and tracking stations. *For related information see:* 06 Auxiliary Systems.

N64-15089 ARO, Inc., Arnold Air Force Station, Tenn.
PROBLEMS IN COMPUTING RADIATION CONTROL FUNCTIONS FOR MARK I
Cord H. Link, Jr. Arnold Eng. Develop. Center, Feb. 1964 74 p refs
(Contract AF 40(600)-1000)
(AEDC-TDR-63-206; AD-428837)

This report assembles the results of studies in the field of spaceflight thermal radiation simulation to provide a system to compute real-time information about the intensity and distribution of thermal radiation fields illuminating a vehicle in space. The details are limited to vehicles in near-earth orbits, but the discussion is sufficiently generalized to indicate how transfer trajectories and alternate primary bodies may be incorporated. Author

N64-15223* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A BRIEF STUDY OF CLOSED-CIRCUIT TELEVISION FOR AIRCRAFT LANDING
John P. Reeder and Joseph J. Kolnick Washington, NASA, Feb. 1964 9 p
(NASA TN D-2185) OTS: $0.50

The results of 45 landings by 7 pilots under good visual conditions, but with the pilot entirely dependent on the television for vision, showed that television provided adequate

forward view during the approach, flare, and ground roll. In addition, 3 takeoffs were made that showed that television provided adequate forward view during the ground roll and climb to about 500 feet. Some problems connected with the use of the television for forward view are discussed, and some recommendations are made for a practical system.
Author

N64-15317 Radio Corp. of America, Patrick AFB, Fla.
ADVANCED RANGE INSTRUMENTATION SHIPS
Nils L. Hanson and A. B. Ward *In* AF Missile Test Center New Data Reduction Methods to Improve Range Data [1963] p 121-143 (See N64-15312 07-01)

A brief description of the past and current use of instrumented ships on Atlantic Missile Range (AMR) is given. As new requirements were placed on the Range, it became necessary to provide more advanced ship capabilities, which led to the development of ARIS 1 and 2. The ARIS 1 equipment configuration and operating concepts are briefly described, as is the proposed method of picking up data from the ship at sea. The reduction of data at AMR from a typical ARIS mission is developed, and a description of AMR plans for the ships' evaluation is presented.
Author

N64-15343 Chance Vought Corp., Dallas, Tex. Aeronautics and Missiles Div.
PRELIMINARY INVESTIGATION OF THE EFFECTS OF MASS-INJECTION ON DYNAMIC STABILITY AT M-17
T. C. Pope and C. J. Stalmach, Jr. 11 Oct. 1963 25 p refs (Rept. 2-59740/3R-479)

Recent interest in ablation effects on stability during reentry has prompted the development of a means of measuring dynamic stability while injecting a gas into the model flow field. This report discusses the development of suitable instrumentation, and presents preliminary results of demonstration runs conducted at several mass flow rates with nine-degree conic models. These runs demonstrate that a gas can be supplied from a stationary reservoir to an oscillating model shell without any increase in the structural damping of the model support. Significant stability effects were measured by injecting nitrogen into the flow field at the nose of slender cones. Static stability effects were also noted as determined from the frequency change between wind-off and wind-on conditions during the dynamic tests. A marked change in the flow field of a sharp-nosed model at high-mass flow rates was observed in Schlieren spark photographs and high speed movies.
Author

N64-15344 Republic Aviation Corp., Farmingdale, N.Y.
LONGSHOT I HYPERSONIC FREE-PISTON TUNNEL
Dec. 1963 55 p refs
(RAC-1884; RD-TR-63-43)

Mechanical aspects as well as the free-piston cycle process are discussed. Instrumentation used and data acquisition and processing techniques are also described. Examples of actual data obtained in Longshot I are included.
Author

N64-15582 Pennsylvania State U., University Park Ordnance Research Lab.
TUNNEL WALL INTERFERENCE EFFECTS ON THE DRAG AND PITCHING MOMENT OF AN AXISYMMETRIC BODY
T. E. Peirce 14 Jan. 1964 227 p
(Contract NOw 63-0209-c)
(TM-501.8871-02; AD-429469)

A method is developed for the prediction of the interference effects of a wind or water tunnel wall on the drag and pitching moment of a three-dimensional body. In determining the effects of tunnel-wall deviations on drag, the investigation is limited to a nonviscous fluid, potential flow, and an axisymmetric deviation. A small deviation is first considered; the magnitude of interference effect is found to be proportional to the thickness of the deviation and the cube of the distance from the deviation. The theory developed for the prediction of the effect of the tunnel walls on the pitching moment of a three-dimensional body of revolution is limited to the prediction of the change in slope of the pitching moment curve for a model at zero angle of attack. The equations for determining the interference effect are developed using the slender body theory.
C.L.W.

N64-15635 ARO, Inc., Arnold Air Force Station, Tenn.
SOME STUDIES IN SUPERSONIC AND HYPERSONIC AERODYNAMICS AT THE VON KARMAN GAS DYNAMICS FACILITY, AEDC
J. Lukasiewicz *In* Bur. of Naval Weapons Proc. of the 6th U.S. Navy Symp. on Aeroballistics [1963] 48 p refs (See N64-15626 07-11)
(Contract AF 40(600)-1000)

Problems of aerodynamic simulation of hypervelocity flight are discussed, and it is suggested that at high altitudes, significant simulation can be attained in terms of Reynolds and Mach numbers alone. Results of studies of reaction jet controls are reviewed, and a method of prediction of their performance is described. Aerodynamics of slender cones under viscous interaction, hypersonic conditions is treated, and a correlation of experimental and theoretical results is reviewed. It is shown that, in this flow regime, $\overline{V}_\infty = \sqrt{C_\infty M_\infty}/\sqrt{Re_\infty}$ is the appropriate similarity parameter.
Author

N64-15670 Speas (R. Dixon) Associates, Manhasset, N.Y.
ANALYSIS VOLUME: ATA DELAY DATA PROGRAM
R. D. Speas, M. H. Smith, A. C. Botsford, E. A. Cutrell, and D. S. Little Oct. 1963 208 p
(Contract FA-WA-4456)

During April and May 1963, 22 of the U.S. airlines recorded the causes of their departure, en route, and arrival delays. These reports were made on a standardized format, amenable to machine processing, as developed by the airlines and the Air Transport Association. The data were placed on punched cards and made available for machine programing, using an IBM 1401 computer, and analysis. Statistical analysis of this data is included in the report.
R.T.K.

N64-15776 Los Alamos Scientific Lab., N. Mex.
ULTRAHIGH TEMPERATURE REACTOR EXPERIMENT (UHTREX) Quarterly Status Report, Period Ending Dec. 20, 1963
6 Feb. 1964 25 p
(Contract W-7405-ENG-36)
(LAMS-3036) OTS: $0.50

The status is given of the construction and completion of the facility for ultra-high-temperature reactor experiments. Included are discussions of the reactor components, gas-flow experiments, helium blower tests, a helium cooling system, dynamic system analysis, neutronic calculations, and fuel preparation.
C.L.W.

N64-15800 Army Research Office, Durham, N.C. Operations Research Technical Assistance Group
PROCEEDINGS OF THE UNITED STATES ARMY OPERATIONS RESEARCH SYMPOSIUM, 26-28 MARCH 1963, PART I

8 Aug. 1963 351 p refs
(Supported by Army)
(AD-424634)

The topics discussed included the following: (1) operations research, (2) CALOGISM—a computer assisted logistics simulation, (3) advanced inventory control techniques, (4) survival curves in a computer simulation model, (5) a computer technique for the allocation of military personnel to major commands, (6) the organization of an operations research group for military service, (7) the definition and measurement of cooperation, conflict, exploitation, and competition, (8) the Centaur war game, (9) application of quantitative techniques in development of maintenance support plans, (10) application of simulation techniques to tactical logistical problems, (11) the environment for effective operations and systems research, (12) the combat value of intelligence and command and control systems, (13) weapon-system model construction, (14) the necessity for objective data from actual combat engagements while current, (15) game theory, (16) a dynamic inventory system, and (17) an operational specification for flight measurement. R.T.K.

N64-15853 Kyoto U. (Japan)
PERFORMANCE OF THE KYOTO UNIVERSITY HYPERSONIC GUN TUNNEL Current Paper No. 3
G. Kamimoto, T. Mori, and T. Kimura Oct. 1963 32 p refs
(CP-3)

A brief description of the design, performance, and operation of a hypersonic gun tunnel is given in this paper. The theoretical calculations of the piston motion, i.e., the acceleration at the initial state and the deceleration at the final state, are presented. Experimental results of the stagnation conditions are compared with those of the theoretical calculation. A few results of the preliminary experiment using a model are described. Author

N64-15901* Northrop Corp., Hawthorne, Calif.
LUNAR LOGISTIC SYSTEM PAYLOAD PERFORMANCE STUDY. VOLUME III: DEVELOPMENT PROGRAMS, AND ESTIMATED SCHEDULES AND COSTS Final Report
Richard E. Horner Jan. 1963 42 p
(NASA Contract NASw-529)
(NASA CR-55672; NSL-63-4) OTS: $4.60 ph, $1.46 mf

The important aspects of the development program for a roving base payload and for four typical function units are described. These are: (1) Roving Base (RBIA); (2) Crew Shelter (S4); (3) Roving Vehicle (RV2); (4) Communications Station (CS1); and (5) Power Generating Station(PS1). Each of the five development programs is discussed as follows: description, analysis and design, reliability, and testing. Estimated development and production costs for the various systems and subsystems are included. R.T.K.

N64-15985 Kyoto U. (Japan)
TRIPLE-DIAPHRAGM TYPE HYPERSONIC SHOCK TUNNEL
G. Kamimoto, T. Akamatsu, and T. Hasegawa Jan. 1962 33 p refs
(CP-1)

Descriptions are given of a triple-diaphragm-type shock tunnel driven by compressed air. The tailoring condition in double-driver gas technique is calculated for various gas combinations, and it is experimentally verified that the tailoring is achieved for air–helium–air combination. Author

11 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; 13 Heat Transfer and Thermodynamics; and 24 Physics, Plasma.

N64-15027 Deutsche Versuchsanstalt für Luft- und Raumfahrt, Aachen (W. Germany) Inst. für Theoretische Gasdynamik
ANALYTIC INVESTIGATION OF THE SPREADING OF SPHERE- AND CYLINDER-WAVES [ANALYTISCHE UNTERSUCHUNG DER AUSBREITUNG VON KUGEL- UND ZYLINDERWELLEN]
H. Rothmann (Thesis—Tech. Hochschule Wien) Oct. 1963 79 p refs In GERMAN
(DVL-280) Available from Vereinigte Universitäts- U. Fachbuchhandlungen, R.-Wagner-Str. 1, Cologne, W. Germany

The spreading of a spherical wave and a cylindrical wave is investigated according to the method of K. Oswatitsch. The characteristics coordinates ξ, η are used as the independent variables. Their magnitudes are constant on the Mach lines. The independent variables are developed according to the potential of a perturbation parameter. The single terms of development x_i, t_i and C_i, W_i, respectively, are alternately determined with the help of iteration methods. (In this case, x is the path, t is the time, C is the sound velocity, and W is the flow velocity.) The shocks at the beginning and end of the wave are derived from the folds in the path–time plane. The calculation is carried through for the cases of both a spherical and a cylindrical wave, each with three parametric values. Trans. by I.v.L.

N64-15028 Deutsche Versuchsanstalt für Luft- und Raumfahrt, Aachen (W. Germany) Inst. für Theoretische Gasdynamik
THE BEHAVIOR OF FORK-LIKE THRUST IN NEAR-SONIC FLOW [DAS VERHALTEN VON GABELSTOSSEN IN SCHALLNAHER STROMUNG]
D. Rues Dec. 1963 80 p refs In GERMAN
(DVL-294) Available from Vereinigte Universitäts- U. Fachbuchhandlungen, R.-Wagner-Str. 1, Cologne, W. Germany

Additional fork-like shocks, which effect the joining of both areas behind the shocks, cannot be formed in flows that have an initial Mach number $\leqq 1.2447$ without the formation in the fork point of a Taylor–Meyer expansion. In the area outside of the expansion, the near-sonic potential equation is solved with the aid of expansion in a power series. In the expansion area, the solution is obtained by transformation of the characteristic coordinates and integration of the hyperbolic differential equation according to the Riemann–Hilbert method. Some magnitudes of the flow field directly in the fork point are given for the near-sonic range. In addition, the flow in the vicinity of the fork point is calculated for the initial Mach number $M_1^* = 1.1$ (The initial Mach number is the Mach number before the shocks.)
Trans. by I.v.L.

N64-15031 Deutsche Versuchsanstalt für Luft- und Raumfahrt, Aachen, (W. Germany) Inst. für Angewandte Gasdynamik
SPHERICALLY SYMMETRIC IMPLOSIONS IN FLUIDS [KUGELSYMMETRISCHE IMPLOSIONEN IN FLÜSSIGKEITEN]

W. Trommsdorff Dec. 1963 53 p refs In GERMAN
(DVL-306) Available from Vereinigte Universitäts- U. Fachbuchhandlungen, R.-Wagner-Str. 1, Cologne, W. Germany

The centripetal energy transport during a spherical symmetric implosion is compared with other centripetal motions of mobile media. These are cylindrical symmetric centripetal shock waves, spherical symmetric centripetal shock waves, and an axial symmetric centripetal motion of matter (metal liners of explosives). A simple concept model is outlined of the spherical symmetric motion of matter; and, using this model, the motion equations of an incompressible fluid are derived. It is shown that a rise in pressure in the liquid accompanies the centripetal motion. Based on this model, an imploding hollow sphere (due to cavitation) is surrounded by an incompressible fluid and is evaluated as to the behavior of the kinematics and energy distribution in the case of fluid compressibility. Also, an apparatus is described that enables measurements of the extreme conditions in the central area of the spherical symmetric imploding cavity. I.v.L.

N64-15063 Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
HYPOTHESIS ON UNIVERSAL EJECTION PROPERTIES OF TURBULENT JETS OF GAS, AND ITS APPLICATION
O. V. Yakovlevskii 20 Dec. 1963 37 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Met. i Toplivo (Moscow), no. 3, 1961 p 40–54
(RSIC-108; AD-428322)

The hypothesis on universal ejection properties of turbulent jets is as follows: If a given jet (index i), propagating under arbitrary conditions, and a standard, submerged, isothermic, free jet (index a) both discharge from the same nozzle, and in the initial cross section have identical impulses, $M_i = M_a$, then these jets also possess similar ejection properties. The hypothesis is applied to the following cases: (1) the initial region of the liquid current in an associated flow; (2) the turbulent jet of a heated gas (with variable thermodynamic properties) in an associated flow; (3) the jet of an incompressible liquid in an associated flow; and (4) a supersonic jet during a calculated and uncalculated regime of discharge. E.K.R.

N64-15160* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
CAVITATION AND EFFECTIVE LIQUID TENSION OF NITROGEN IN A TUNNEL VENTURI
Robert S. Ruggeri and Thomas F. Gelder Washington, NASA, Feb. 1964 35 p refs
(NASA TN D-2088) OTS: $1.00

Cavitation of liquid nitrogen was induced on the walls of a Venturi with a 1.377-inch throat diameter in a closed-return hydrodynamic tunnel. Just prior to incipient cavitation, the minimum local wall pressure was significantly less than the vapor pressure corresponding to the stream liquid temperature; this pressure difference is called effective liquid tension. Effective tensions ranged from 8 to 60 ft of nitrogen head for approach velocities from 17 to 55 fps, respectively. Temperatures and pressures measured within regions of well-developed cavitation were in thermodynamic equilibrium but were less than the temperature and the saturation vapor pressure of the approaching stream. Measured temperature depressions were as high as 3° F and corresponded to a head depression of 9 ft of liquid nitrogen (at the temperatures studied). These depressions increased with both stream velocity and extent of cavitation. Author

N64-15161* National Aeronautics and Space Adminstration. Lewis Research Center, Cleveland, Ohio
CORRELATION OF A TURBULENT AIR-BROMINE COAXIAL-FLOW EXPERIMENT
Robert G. Ragsdale, Herbert Weinstein, and Chester D. Lanzo Washington, NASA, Feb. 1964 35 p refs
(NASA TN D-2121) OTS: $1.00

A previously published laminar analysis of an isothermal coaxial-flow system is extended to turbulent flow. Mixing-length theory is used to develop a general expression for a dimensionless eddy viscosity. Experimental data were obtained for a slow-moving bromine stream injected into a fast-moving airstream. Axial variations of average bromine concentration were measured optically for air Reynolds numbers from 1,330 to 49,300, bromine Reynolds numbers from 255 to 3,850, and air-to-bromine initial-velocity ratios from 0.83 to 0.97 and 1.25 to 49. For the lowest bromine Reynolds number of 255, an air Reynolds number of 1,730, and an initial-velocity ratio of 4.3, the data were in agreement with the laminar analysis. For all other runs, the data were well represented by introducing a value of the dimensionless eddy viscosity ϵ^+ into the analysis to account for turbulence. Author

N64-15176* Yeshiva U., New York, N.Y.
INTEGRAL EQUATIONS AND INEQUALITIES IN THE THEORY OF FLUIDS
J. L. Lebowitz and J. K. Percus (New York U.) Dec. 1963 11 p refs Repr. from J. Math. Phys., v. 4, no. 12, Dec. 1963 p 1495–1505
(NASA Grant NsG-227-62; Contract AT(30-1)-1480; AF Grant AFOSR 62-64)

Using the method of functional Taylor expansion developed previously, an extensive set of equations is obtained for the distribution functions and Ursell functions in a classical fluid. By terminating the Taylor expansion after a finite number of terms and retaining the remainder, inequalities for the distribution functions and thermodynamic parameters of the fluid are also obtained. For the case of positive interparticle potentials, the inequalities first found by Lieb are recovered. For nonpositive potentials, new inequalities (some also obtained by Penrose) are derived. These inequalities are applied to the case of a hard-sphere fluid in three dimensions where they are compared with the results of machine computations and approximate theories. Different inequalities, not obtainable from the above considerations, and some properties of the fugacity expansions, are also derived. Author

N64-15219* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
EFFECT OF AMBIENT AIR VELOCITY ON ATOMIZATION OF TWO IMPINGING WATER JETS
David A. Bittker Washington, NASA, Feb. 1964 36 p refs
(NASA TN D-2087) OTS: $1.00

Drop-size distributions were measured for the sprays formed by two 0.089-in.-diam. impinging water jets. Jet impingement angles of 30°, 60°, and 90° and jet velocities of 30, 60, and 74 fps were used. These variables were held constant, while the primary variable of this work (i.e., the difference between the ambient air velocity and the liquid jet velocity) was changed from 0 to 120 fps. All distributions show bimodal characteristics with number–median diameters of approximately 200 and 500 microns for the two modes. For low jet velocities, increasing the velocity difference decreases

the mass–median diameter of the large-diameter mode and increases the percentages of mass and drops in the small-diameter mode. In the range of velocity difference 0 to 120 fps, the volume–number–mean and mass–median diameters of the complete spray decrease as velocity difference increases, except for the highest jet velocity. Author

N64-15225 United Kingdom Atomic Energy Authority, Harwell (Gt. Brit.) Atomic Energy Research Establishment
SAMPLING PROBE STUDIES OF THE GAS CORE IN ANNULAR TWO-PHASE FLOW. PART II: STUDIES OF THE EFFECT OF PHASE FLOW RATES ON PHASE AND VELOCITY DISTRIBUTION
L. E. Gill, G. F. Hewitt, and P. M. C. Lacey 1963 54 p refs Submitted for Publication
(AERE-R-3955)

Data are presented for the distribution of liquid-droplet mass velocity and local linear velocity for the gas core in air–water annular flow. The liquid mass-velocity profiles exhibit maxima at the axis of the tube, and the droplet volume concentration remains constant across the tube. The gas-velocity profiles undergo a marked transformation as the liquid rate is changed. They obey a logarithmic law in all cases, but for higher liquid rates the constant in this law diminishes from its classical value. In the low liquid rate region a promising correlation is obtained between the liquid film thickness and the equivalent roughness height calculated from pressure gradient. The concentration of droplets appeared to be almost independent of gas rate at any given liquid rate, and this fact facilitates interpolation of the experimental data for entrainment mass flow. Author

N64-15229* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
HYDRODYNAMIC LUBRICATION
William J. Anderson *In its* Advanced Bearing Technol. 1964 p 63–96 refs (See N64-15226 07-01) GPO: $1.75

Hydrodynamic bearing applications are considered for two broad classes of bearings—those that support radial loads and those that support thrust or axial loads. Basic hydrodynamic theory is developed, after which applications to the analysis of radial and thrust bearings are discussed. Pressure conditions are examined that must prevail to maintain flow continuity with various film configurations in an effort to evolve a physical understanding of pressure development in an oil film. Investigations are made of the dynamic loads and instabilities in journal bearings. C.L.W.

N64-15230* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
HYDROSTATIC LUBRICATION
William J. Anderson *In its* Advanced Bearing Technol. 1964 p 97–108 refs (See N64-15226 07-01) GPO: $1.75

A discussion is given concerning the behavior of incompressible-fluid hydrostatic bearings. The characteristics of hydrostatic bearings are discussed and are followed by an analysis of the simplest type of hydrostatic thrust bearing. Compensation is explained, and a description is given of flow through compensating resistances. Determination of bearing operating conditions and of optimum bearing proportions is presented, and a general procedure for obtaining the stiffness of a bearing is given. C.L.W.

N64-15231* Litton Industries, Inc., Woodland Hills, Calif. Guidance and Control Systems Div.
GAS-LUBRICATED BEARINGS
J. S. Ausman *In* NASA, Lewis Res. Center Advanced Bearing Technol. 1964 p 109–138 refs (See N64-15226 07-01) GPO: $1.75

A study is made of the problems that are presented by gas-lubricated bearings. Analysis is complex because the compressibility of gases makes the Reynolds equation nonlinear. Because of this nonlinearity, no general analytical solution to this equation has been found, and approximate methods of solution invariably rely on some means of linearizing the equation. Some methods for obtaining approximate solutions are discussed. Results are presented in forms intended to illustrate the fundamental nature and behavior of gas lubrication. Typical design curves are also given for guides. C.L.W.

N64-15246 Library of Congress, Washington, D.C. Aerospace Information Div.
CONTRIBUTION TO THE APPROXIMATION THEORY OF COMPRESSIBLE TURBULENT BOUNDARY LAYERS
Alfred Walz (DVL) 26 Aug. 1963 98 p refs Transl. into ENGLISH of a 2-part study For German versions see N62-14508 12-11 and N62-14512 12-11
(AID-T-63-110; AD-418354) OTS: $8.60 ph, $3.14 mf

CONTENTS:
1. CONTRIBUTION TO THE APPROXIMATION THEORY OF COMPRESSIBLE TURBULENT BOUNDARY LAYERS. [I] 42 p refs (See N64-15247 07-11)
2. CONTRIBUTION TO THE APPROXIMATION THEORY OF COMPRESSIBLE TURBULENT BOUNDARY LAYERS II. CALCULATION OF UNIVERSAL FUNCTIONS AND EXAMPLES 52 p refs (See N64-15248 07-11)

N64-15247 Deutsche Versuchsanstalt für Luft- und Raumfahrt, Freiburg (W. Germany) Inst. für Angewandte Mathematik und Mechanik
CONTRIBUTION TO THE APPROXIMATION THEORY OF COMPRESSIBLE TURBULENT BOUNDARY LAYERS [I]
Alfred Walz [Mar. 1959] *In* Library of Congr. Contrib. to the Approximation Theory of Compressible Turbulent Boundary Layers 26 Aug. 1963 42 p refs Transl. into ENGLISH of Pt. I of the study "Beitrag zur Naeherungstheorie kompressibler turbulenter Grenzschichten" (See N64-15246 07-11) OTS: $8.60 ph, $3.14 mf
(DVL-84)

The possibility of finding the available infinite number of integral conditions for improving the approximation theory of laminar and turbulent boundary layers is examined. It is then shown that empirically found laws for shearing stress and dissipation of turbulent layers in the compressible area can also be generalized for the case of flow with heat-transition. Drag coefficients of the flat plate up to about Mach 7, calculated on the basis of this generalization, correspond satisfactorily to the available measuring results. Some ideas are discussed for improving and facilitating the approximation theory.
Author

N64-15248 Deutsche Versuchsanstalt für Luft- und Raumfahrt, Freiburg (W. Germany) Inst. für Angewandte Mathematik und Mechanik
CONTRIBUTION TO THE APPROXIMATION THEORY OF COMPRESSIBLE TURBULENT BOUNDARY LAYERS. II. CALCULATION OF UNIVERSAL FUNCTIONS AND EXAMPLES

Alfred Walz [Oct. 1960] *In* Library of Congr. Contrib. to the Approximation Theory of Compressible Turbulent Boundary Layers 26 Aug. 1963 52 p refs Transl. into ENGLISH of Pt. II of the study "Beitrag zur Naeherungstheorie kompressibler turbulenter Grenzschichten" (See N64-15246 07-11) OTS: $8.60 ph, $3.14 mf
(DVL-136)

The universal functions of the theory have been evaluated for a turbulent boundary layer and presented in analytic form using velocity profile, Mach number, and heat-transfer parameters. The theory is adapted for use with electronic computers. For the friction coefficient of the flat plate, new results showing the influence of Mach number and heat transfer are presented. Author

N64-15253 Avco-Everett Research Lab., Everett, Mass.
EFFECT OF NONEQUILIBRIUM ON THE HYPERSONIC LAMINAR BOUNDARY LAYER
P. De Rienzo, F. Berner, A. D. Woods, and J. D. Teare *In* AF Systems Command Trans. of the 8th Symp. on Ballistic Missile and Space Technol., Vol. 2 [1963] 35-64 refs (See N64-15251 07-01)
(Contract AF 04(694)-239; Contract AF 04(694)-33)

An approximate method is formulated for the determination of the nonequilibrium, compressible, laminar boundary layer, both with and without the restriction of vibrational equilibrium. The method involves solution of the rate equations for species production and vibrational relaxation along "effective" particle paths determined from mass continuity considerations. The velocity and enthalpy time histories along these paths are then specified from the appropriate locally similar equilibrium or frozen boundary-layer analyses. Application of the method is illustrated for the hypersonic laminar boundary layer along a sharp cone. Results are compared with more exact numerical solutions of the nonequilibrium boundary-layer equations, and the limitations of the approximate method are indicated. The technique is used to determine the effects of altitude and cone angle on the nonequilibrium boundary layer, together with the influence of variations in the chemical rate constants and vibrational relaxation models. The application of binary scaling is discussed. Author

N64-15299 Boeing Scientific Research Labs., Seattle, Wash.
COMPARISON OF THE STABILITY OF POISEUILLE FLOW AND THE BLASIUS PROFILE FOR FLEXIBLE WALLS
F. D. Hains Jun. 1963 27 p refs
(DI-82-0264; Flight Sci. Lab. Rept. 75)

Results demonstrate that if a neutral stability curve is to correspond to a given flexible wall, the Reynolds number must be changed by variation of the one quantity that was not used in the nondimensionalization of the boundary condition. If the Reynolds number is varied in some other way, the resultant curve corresponds to an infinite number of walls and is of little practical value. For a particular point on the stability diagram for which the Tollmein-Schlichting mode is stable, two other unstable eigenvalues were found. One value corresponds to waves traveling upstream and the other corresponds to waves traveling downstream. Increased wall damping tends to stabilize these modes, whereas increased tension tends to destabilize them further. As the wall is made rigid by increasing the wall damping or the tension, it appears that two different limits are approached. R.T.K.

N64-15370 Electro-Optical Systems, Inc., Pasadena, Calif.
EFFECT OF BASE BLEED ON THE LAMINAR BASE FLOW
H. H. King and E. Baum May 1963 40 p refs
(ARPA Order 203-A1-63; Contract DA-04-495-AMC-28-(Z); Proj. Defender)
(EOS-RN-10; AD-337120)

Finite-difference separated shear-layer calculations are employed to determine the effects of base bleed on the laminar base flow. Calculations for typical cold bodies at reentry and wind-tunnel conditions show that a significant alteration of the wake thermal properties may be obtained by moderate mass-injection rates. The results suggest that base blowing is more effective than an equal body blowing rate for cooling the downstream wake. Author

N64-15389* Southwest Research Inst., San Antonio, Tex.
A REVIEW OF RESEARCH STUDIES ON BUBBLE MOTION IN LIQUIDS CONTAINED IN VERTICALLY VIBRATING TANKS Technical Report No. 1
Franklin T. Dodge 30 Dec. 1963 24 p refs
(NASA Contract NAS8-11045; SwRI Proj. 13-1391-2)
(NASA CR-55575) OTS: $2.60 ph, $0.92 mf

Published reports that consider the motion of gas bubbles in a vertically vibrating liquid are reviewed. Experiments show that bubbles in vibrated liquids do not always rise upward through the liquid, but may instead remain stationary or sink. Presently available theories explain these observations qualitatively but are not in good agreement quantitatively with test results. Author

N64-15391 United Kingdom Atomic Energy Authority, Harwell (Gt. Brit.) Atomic Energy Research Establishment
INSTABILITIES IN TWO-PHASE FLOW PRELIMINARY EXPERIMENTS
D. J. Pulling and J. G. Collier 1963 17 p refs
(AERE-M-1105) HMSO: 2s 6d net

Experiments have been performed to study the conditions associated with the production of oscillatory instabilities when evaporation occurs in two parallel heated channels. The effects of different inlet flow conditions were studied, first using subcooled water (at 60° C), and later, using two-phase steam and water mixtures at inlet. Although these were preliminary experiments, and were of a qualitative nature, some important effects were noted. From these tests, it is concluded that a negative slope on the pressure drop–mass flowrate curve is not a necessary condition for producing oscillatory instabilities. This agrees with earlier evidence and the theoretical predictions of Quandt. Also it appears that, when two-phase conditions exist at the inlet to the heated section, no oscillatory instability is likely to occur. Author

N64-15517 Polytechnic Inst. of Brooklyn, N.Y.
A REVIEW OF THE WORK PERFORMED AT THE POLYTECHNIC INSTITUTE OF BROOKLYN AEROSPACE INSTITUTE [Final Report]
Antonio Ferri and Victor Zakkay Wright-Patterson AFB, Ohio, Aerospace Labs., Dec. 1963 30 p refs
(ARL-63-227; AD-427611)

Theoretical and experimental investigations of problems connected with hypersonic flows and hypersonic wind tunnels are reviewed. This research is concerned with two- and three-dimensional boundary-layer flows and the determination of the pressure distribution about hypersonic bodies. A study of low density effects at hypersonic speeds is made both theoretically and experimentally. During the early part of the research, a study of an advanced device for hypersonic wind tunnel operation is carried out. An investigation of supersonic combustion is made. Theoretical and experimental results of mass transfer

are presented. Finally, some problems bearing on thermochemistry and real-gas effects are investigated. Author

N64-15521 ARO, Inc., Arnold Air Force Station, Tenn.
THEORETICAL BASE PRESSURE ANALYSIS OF AXISYMMETRIC EJECTORS WITHOUT INDUCED FLOW
R. C. Bauer Arnold Eng. Develop. Center, Jan. 1964 49 p refs
(Contract AF 40(600)-1000)
(AEDC-TDR-64-3; AD-428187)

The two-dimensional supersonic base pressure theory, which applies to two-dimensional systems with straight jet boundaries, has been modified to be more applicable to axisymmetric ejector systems. The modification consists of a new theory for estimating the peak recompression static pressure that is applicable to either axisymmetric or two-dimensional jets having straight or curved boundaries. Significantly, the recompression mechanism is not independent of viscous effects for systems that produce a nonuniform inviscid flow field. Both the recompression theory and the modified base pressure theory are experimentally verified for the case of isoenergetic mixing and negligible initial boundary layer. The recompression theory is shown to agree with experimental results to within ±10 percent, whereas the experimental base pressure results have a standard deviation of 6 percent with respect to the modified base pressure theory. Author

N64-15524 Avco-Everett Research Lab., Everett, Mass.
EFFECTS OF NONEQUILIBRIUM ON THE HYPERSONIC LAMINAR BOUNDARY LAYER
P. De Rienzo, F. Berner, A. D. Wood, and J. D. Teare Sep. 1963 32 p
(Contract AF 04(694)-33; Contract AF 04(694)-239)
(BSD-TDR-63-210; Res. Rept.-171; Avco-RAD-TM-64-2; AD-429808)

An approximate method is formulated for the determination of the nonequilibrium compressible laminar boundary layer, both with and without the restriction of vibrational equilibrium. The method involves solution of the rate equations for species production and vibrational relaxation along "effective" particle paths determined from mass continuity considerations. The velocity and enthalpy time histories along these paths are then specified from the appropriate locally similar equilibrium or frozen boundary-layer analyses. Application of the method is illustrated for the hypersonic laminar boundary layer along a sharp cone. Results are compared with more exact numerical solutions of the nonequilibrium boundary-layer equations, and the limitations of the approximate method are indicated. Finally, the technique is used to determine the effects of altitude and cone angle on the nonequilibrium boundary layer, together with the influence of variations in the chemical rate constants and vibrational relaxation models. The application of binary scaling is discussed. Author

N64-15599 Syracuse U. Research Inst., N.Y.
THE WALL-JET IN A MOVING STREAM
V. Kruka and S. Eskinazi 20 Aug. 1963 53 p refs
(Contract Nonr-669(16))
(ME-937-6309F; AD-421057)

The wall-jet is the flow of fluid that emanates from a narrow slot and blows over a rigid wall. This flow has drawn considerable basic and applied interest as it has the characteristics of both a boundary layer and a free mixing flow. The present experimental investigation is of a plane, steady, turbulent wall-jet with negligible longitudinal pressure gradients in a constant moving stream, and with varying ratios of jet to free-stream velocity. The analysis and experimental results are compared with those of previous investigators, and a definite comparison with quiescent free-stream studies is made. E.W.

N64-15609 Argonne National Lab., Ill. Radiological Physics Div.
A LABORATORY INVESTIGATION OF THE LAGRANGIAN AUTOCORRELATION FUNCTION IN A STRATIFIED FLUID
Paul Frenzen (Ph.D. Thesis—Chicago U.) Nov. 1963 187 p refs
(Contract W-31-109-eng-38)
(ANL-6794)

Experimental results are presented that demonstrate the stability dependence exhibited by the Lagrangian autocorrelation function, which is the principal statistical characteristic contained in the Taylor theory. Investigation of turbulent diffusion in a towing channel is described. Measurements of consecutive displacements of tracer particles suspended within grid-produced fields of homogeneous turbulence were corrected for decay and used to compute Lagrangian autocorrelation functions. Results in the form of correlograms and a number of turbulence characteristics obtained under conditions of three different initial-turbulence intensities in fluid stratifications, ranging from weak instability to strong stability, are compared. C.L.W.

N64-15613 New York U., N.Y. AEC Computing and Applied Mathematics Center
NUMERICAL CALCULATIONS OF MULTIDIMENSIONAL SHOCKED FLOWS
Samuel Z. Burstein 15 Nov. 1963 66 p refs
(Contract AT(30-1)-1480)
(NYO-10433)

Numerical methods are described for the calculation of two-dimensional time-dependent inviscid flows which contain shocks. The problems were considered to be time dependent and their solutions are found asymptotically for large values of time ($t \to \infty$). Results are given for oblique shock reflection and Mach reflection. The numerical scheme was tested for values of Mach numbers that ranged between $1.3 \leq M_\infty \leq 3.0$. The conservation equations describing such flows are integrated over a region that contains multiple shocks. Two of the difference methods described are high order accuracy schemes (the methods of Lax and Wendroff), which closely approximate the jump conditions across discontinuities and give the shock transition within three mesh widths. The initial value problems that were considered had initial data close to the asymptotic solution and data that were arbitrarily remote from the desired solution. Author

N64-15617 Stanford U., Calif.
STUDIES IN HYPERSONIC FLOW THEORY
Milton Van Dyke Feb. 1963 9 p refs
(Contract AF 49(638)-965)
(AFOSR-4785; AD-408349)

Research in hypersonic-flow theory covered the following areas: (1) effects of nose bluntness on a slender body; (2) flow past inclined blunt bodies; (3) unsteady hypersonic-flow theory; (4) viscous effects on blunt bodies; (5) irreversible processes in dilute gases; (6) blunt bodies at low Reynolds number; (7) vortical layer on an inclined cone; and (8) interaction of entropy and boundary layers. E.K.R.

N64-15626 Bureau of Naval Weapons, Washington, D.C.
PROCEEDINGS OF THE 6TH UNITED STATES NAVY SYMPOSIUM ON AERO-BALLISTICS
[1963] 687 p refs Symp. held at Ft. Lesley J. Mc Nair, Washington, D.C., 31 Oct.–1 Nov. 1963 Classified papers published in a separate vol.
(AD-429753)

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20. ANALYTIC SOLUTIONS TO THE EQUATIONS OF MOTION OF MISSILES HAVING SIX DEGREES OF FREEDOM W. E. De Grafft (Naval Ordnance Lab.) 64 p refs (See N64-15645 07-23)

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21. RESULTS OF AN EXTENDED BOUNDARY LAYER THEORY E. W. Schwiderski and H. J. Lugt (Naval Weapons Lab.) 6 p refs (See N64-15646 07-11)

22. AEROTHERMOELASTIC TESTING IN A FREE JET W. H. Terrill (Gen. Dyn./Pomona) 23 p refs (See N64-15647 07-11)

N64-15632 Naval Ordnance Test Station, China Lake, Calif.
AN EXPERIMENTAL INVESTIGATION OF THE FLOW PHENOMENA INVOLVED IN GASEOUS THRUST DIRECTION CONTROL DEVICES
F. G. Buffum, Jr., E. W. Price, and R. O. Slates *In* Bur. of Naval Weapons Proc. of the 6th U.S. Navy Symp. on Aeroballistics [1963] 77 p refs (See N64-15626 07-11)

The flow field involved in supersonic, jet–jet interactions as pertaining to gaseous thrust-direction-control devices was investigated using two-dimensional glass-walled nozzles. The work included shadowgraph, schlieren, and pulsed-laser interferometer pictures of the interaction phenomena in the vicinity of the injection port for various port positions and over a range of primary and secondary pressures. Pressure measurements for the cases examined are presented. An investigation of the extent of secondary gas penetration into the primary stream using reacting gas techniques and gas sampling methods is reported. Author

N64-15633 Applied Physics Lab., Johns Hopkins U., Silver Spring, Md.
BASIC TVC EXPERIMENTS WITH GAS INJECTION AND PROBES
R. E. Walker, A. R. Stone, and M. Shandor *In* Bur. of Naval Weapons Proc. of the 6th U.S. Navy Symp. on Aeroballistics [1963] 50 p refs (See N64-15226 07-11)
(Sponsored by Bur. of Naval Weapons)

Data are presented on side forces generated by lateral injection of sonic gas jets and by probe immersion into a constant-area supersonic duct flow (M = 1.9 to 2.9) provided by a rocket-motor exhaust. Conclusions reached as a result of this study include: (1) The maximum observed specific impulse for gas injection and side force to drag ratio for probes is only slightly above predictions of linear theory. (2) At least two mechanisms can be suggested to explain submaximum performance—induced shock-wave reflections and incomplete expansion of mixed gases. P.V.E.

N64-15642 Douglas Aircraft Co., Inc., El Segundo, Calif.
SOLUTION OF THE GENERAL BOUNDARY-LAYER EQUATIONS FOR COMPRESSIBLE LAMINAR FLOW, INCLUDING EQUILIBRIUM DISSOCIATION
Darwin W. Clutter and A. M. O. Smith *In* Bur. of Naval Weapons Proc. of the 6th U.S. Navy Symp. on Aeroballistics [1963] 37 p refs (See N64-15626 07-11)
(Contract NOw-60-0533-c)

The method of solution consists of replacing the partial derivatives with respect to the flow direction by finite differences, while retaining the derivatives in a direction normal to the boundary, so that the partial differential equations become approximately by ordinary differential equations. Arbitrary fluid properties may be used in the method of solution; that is, they are inputs in the computer program in the form of formulas or tables as functions of local enthalpy and pressure. The method has been programed on an IBM 7094 computer, and solutions for a variety of flows are presented. The flows include cases of heat transfer, mass transfer, and discontinuities in the boundary conditions over the range of Mach numbers from 0 to 20. Flows in which equilibrium dissociation occurs are presented. Also, studies of the effect of various fluid-property laws on the solution and of the effect of transverse curvature on the flow over cones are presented. Author

N64-15643 General Applied Science Labs., Inc., Westbury, N.Y.
FINITE DIFFERENCE CALCULATION OF HYPERSONIC WAKES
Seymour L. Zeiberg and Gary D. Bleich *In* Bur. of Naval Weapons Proc. of the 6th U.S. Navy Symp. on Aeroballistics [1963] 44 p refs (See N64-15626 07-11)
(Contract NOrd-18053; Contract AF 19(628)-500; ARPA Order 166)

A finite-difference method is used to solve the system of equations governing the hypersonic air wake with nonequilibrium air chemistry; both laminar and turbulent transports (for slender bodies) are incorporated. Numerical results for laminar flow are compared with results of an integral method. Additional calculations are presented for the effect of oxygen–electron attachment processes in turbulent wakes, for a parametric-type study of turbulent diffusivity models, and for the effects of mass entrainment in a blunt-body turbulent wake. Author

N64-15646 Naval Weapons Lab., Dahlgren, Va.
RESULTS OF AN EXTENDED BOUNDARY LAYER THEORY
Ernst W. Schwiderski and Hans J. Lugt *In* Bur. of Naval Weapons Proc. of the 6th U.S. Navy Symp. on Aeroballistics [1963] 6 p refs (See N64-15626 07-11)

The "extended" boundary-layer theory, developed to describe laminar flows of incompressible fluids, uses the complete Navier–Stokes equations and is connected with the following constructive procedure: (1) A Taylor expansion is performed around a certain line of interest; the Navier–Stokes equations are reduced to an infinite set on ordinary differential equations. (2) A local similarity assumption that justifies the concept of "boundary layer" reduces the infinite set of differential equations to a finite set that is subject to numerical integration. P.V.E.

N64-15647 General Dynamics/Pomona, Calif.
AEROTHERMOELASTIC TESTING IN A FREE JET
W. H. Terrill *In* Bur. of Naval Weapons Proc. of the 6th U.S. Navy Symp. on Aeroballistics [1963] 23 p refs (See N64-15626 07-11)

The testing capabilities of the Ordnance Aerophysics Laboratory free-jet facility are shown and compared with two other free-jet installations. Techniques of model design, support, and protection for aerothermoelastic testing are discussed and illustrated. The dynamic pressure–Mach number requirements for two hypothetical missile interceptors are examined in terms of present free-jet capabilities. It is shown that the high performance of interceptors limits their low-altitude simulation in available free jets to about Mach 3 and below. Methods of programing the aerothermoelastic test conditions for an interceptor are examined. Author

N64-15703 Princeton U., N.J.
THE TWO-DIMENSIONAL, TURBULENT WALL JET WITH AND WITHOUT AN EXTERNAL FREE STREAM
A. Verhoff May 1963 120 p refs
(Contract Nonr 1858(14))
(Rept. 626; AD-406073) OTS: $9.60

For the case of the plane turbulent wall jet, the growth of the jet and the maximum velocity decay are predicted based on the assumption that the shear stress distribution and the velocity distribution across the jet remain similar over the useful range of downstream positions. The approach used in the analysis of the plane turbulent wall jet is extended to the more general case of a turbulent wall jet beneath a secondary uniform stream. The velocity distribution and shear stress distribution are expressed in terms of a number of similarity functions and the ratio of the free stream velocity to the maximum velocity in the jet profile. Author

N64-15767 Naval Weapons Lab., Dahlgren, Va. Computation and Analysis Lab.
VISCOUS FLUID MOTIONS AROUND DIHEDRAL ANGLES
Ernst W. Schwiderski and Hans. J. Lugt Dec. 1963 43 p refs
(NWL-1901; AD-429926)

General wedge and corner problems lead to the introduction of complex Navier–Stokes equations of complex laminar motions, the real parts of which describe real laminar flows. Under the nonslip condition at the surface of a dihedral angle, the general solution of the complex Navier–Stokes equations is established on the basis of the corresponding integral of the Stokes equations of slow motions. The latter integration is accomplished in terms of slow-motion eigenfunctions with real eigenvalues for infinite and semi-infinite plates and with complex eigenvalues for wedges and corners. The results obtained render valuable information about the flow properties at the leading or trailing edge of a dihedral angle. In particular, laminar flows around dihedral angles are shown to be nonanalytic in their dependence upon the corresponding wedge or corner angles. Author

N64-15768 British Hydromechanics Research Assn., Harlow Information Dept.
SOME REFERENCES ON DIFFERENT ASPECTS OF LIP SEALS
Oct. 1963 7 p 36 refs
(BIB-15)

An annotated bibliography on different aspects of lip seals is presented. I.v.L.

N64-15784 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
ASYMPTOTIC EXPANSIONS OF NAVIER-STOKES SOLUTIONS IN THREE DIMENSIONS FOR LARGE DISTANCES
Stephen Childress 15 Jan. 1964 74 p refs
(NASA Contract NAS7-100; NASA Contract NASw-6; Contract AF 49(638)-521)
(NASA CR-53055; JPL-TR-32-480) OTS: $7.60 ph, $2.42 mf

This report studies the stationary flow field at large distances from a finite obstacle moving uniformly in a viscous, incompressible fluid. The principal results consist of asymptotic expansions, uniformly valid for large distances, of the velocity and of the pressure of the flow field. The calculated results include the following: for the case of axially symmetric

flow, a uniformly valid expansion of the velocity to order r^{-2} inclusive and of the pressure to order r^{-3} inclusive, r being the distance from the obstacle; for the general case, an expansion of the velocity to order $r^{-3/2}$ inclusive and of the pressure to order r^{-2} inclusive. Author

N64-15788* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

INVESTIGATION OF LIQUID AND GASEOUS SECONDARY INJECTION PHENOMENA ON A FLAT PLATE WITH M=2.01 TO M=4.54

Mack W. Dowdy and John F. Newton, Jr. 23 Dec. 1963 108 p refs

(NASA Contract NAS7-100)

(NASA CR-53063; JPL-TR-32-542) OTS: $9.10 ph, $3.44 mf

An experimental program has been conducted in the 20-in. supersonic wind tunnel to study the interaction effects produced when liquid or gaseous nitrogen is injected in a direction perpendicular to a supersonic stream on a flat plate. The tests provided useful information about the effects of free-stream Mach number, free-stream Reynolds number, and injection pressure on the shock structure and pressure distribution induced on the plate by the injection process. Pressure distributions in the injector region, Schlieren, spark shadowgraphs, and motion pictures provided details about the flow interaction, which should assist in the development of more meaningful analytical models of secondary injection. Author

N64-15790 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

THE FREE-PISTON SHOCK TUBE DRIVER: A PRELIMINARY THEORETICAL STUDY

Gerald A. Roffe 15 Dec. 1963 21 p refs

(NASA Contract NAS7-100)

(NASA CR-53059; JPL-TR-32-560) OTS: $2.60 ph, $0.83 mf

The concept of a free-piston shock tube driver is discussed in detail and an analysis is made of the heat losses encountered in the compression process. Design optimization is discussed, and methods of controlling driver performance are outlined in detail. Author

N64-15801 Toronto U. (Canada). Inst. of Aerophysics

AN EXPERIMENTAL INVESTIGATION OF THE FLOW IN AND BEHIND TWO-DIMENSIONAL JET SHEETS BOUNDING A CAVITY

K. Sridhar Aug. 1963 208 p refs

(UTIA-94)

Experiments for two-dimensional jet sheets bounding a cavity were carried out for six different configurations of nozzle height and lateral position (cavity depth) and at four different pressure ratios. A main finding of this work is that the experimental flow, in a number of respects, is not in conformity with the usual theoretical models. The velocity profiles at different horizontal stations along the "curved" jet sheets were found to be similar provided the stations considered were not too close to the nozzle exit. The experimental results also indicated the flow in the cavity to be highly rotational and that in the region not too close to the boundaries, the vorticity may be approximated as uniform. Further, the total circulation about a specified circuit in the cavity was found to vary linearly with the theoretical jet Mach number, the slopes of the lines changing with the configuration. Author

N64-15880* National Bureau of Standards, Boulder, Colo. Cryogenic Engineering Lab.

A PRELIMINARY STUDY OF THE ORIFICE FLOW CHARACTERISTICS OF LN^2 AND LH^2 DISCHARGING INTO A VACUUM

James A. Brennan [1963] 29 p refs Prepared for the Cryog. Eng. Conf., Boulder, Colo., Aug. 19–21, 1963

(NASA Order R-45)

(NASA CR-55329; NBS-R-291; Paper No. E-6) OTS: $2.60 ph, $1.07 mf

Flow characteristics of the propellants through holes made in the tank walls by meteoroid puncture were studied. Overall discharge coefficients for small-diameter, thick-plate orifices were determined as a function of discharge pressure using liquid nitrogen and liquid hydrogen. Discharge pressures from 3 mm Hg to slightly above the triple point were investigated. Flow characteristics appear to be sensitive to discharge pressure and the condition of the liquid upstream of the orifice. A marked difference in flow pattern was observed that depended on whether the liquid was nearly saturated or there was two-phase flow. If the liquid was nearly saturated and no gas phase passed through the orifice, the flow could be very nearly predicted by the adiabatic, incompressible flow equations. When gas phase was present upstream of the orifice, it appeared that solid formation could take place in the orifice itself and thereby retard the flow. In addition to the orifice discharge coefficients, a general discussion of observed flow patterns is presented. Author

N64-15887* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

THE LOW AND THE HIGH PRANDTL NUMBER APPROACHES FOR HEAT TRANSFER IN LAMINAR FLOW OF INCOMPRESSIBLE FLUIDS WITH CONSTANT MATERIAL PROPERTIES

Ernst W. Adams 6 Mar. 1962 49 p refs

(NASA TM X-54568; MTP-AERO-62-19) OTS: $4.60 ph, $1.67 mf

Exact closed form solutions of the boundary-layer equations can be derived for the Nusselt number Nu(x) at the leading edge $x = 0$ and, in the limits $Pr \to 0$ and $Pr \to \infty$, on the surface $x \geq 0$ of arbitrary bodies in planar uniform flow. Published results of exact and of approximate solutions for Nu(x)/Nu(0) in the range $0 < Pr < \infty$ are compared to the results of the $Pr \to 0$ and the $Pr \to 0$ and the $Pr \to \infty$ methods. The $Pr \to 0$ method yields an upper limit for Nu(x)/Nu(0). The presented examples show that the $Pr \to \infty$ method yields a lower limit for Nu(x)/Nu(0) in case of slender bodies. Both methods yield the exact solution for Nu(x)/Nu(x*) in the cases for which similarity solutions exist. The $Pr \to 0$ and the $Pr \to \infty$ methods are applicable to obtain engineering estimates of heat transfer. Author

N64-15888* Minnesota U., Minneapolis Rosemount Aeronautical Labs.

TURBULENT BASE FLOW INVESTIGATIONS AT MACH NUMBER 3

R. E. Larson, C. J. Scott, D. R. Elgin, and R. E. Seiver Jul. 1962 38 p refs

(NASA Contract NAS8-1698; Contract DA-11-022-ORD-3969) (NASA CR-55718; Res. Rept. 183) OTS: $3.60 ph, $1.34 mf

This report presents results of an experimental investigation of supersonic base flow processes under turbulent wake flow conditions. The measurements were made in the near-wake region of a two-dimensional model at a free-stream Mach number of 3. Local heat fluxes and pressures were measured on the base of the model for various cooling rates over the transitional to fully turbulent flow regimes. It was observed that base temperature had a small but measurable influence on heat-transfer coefficient and mean base pressure. For turbulent flow with the base at recovery temperature, profiles of impact pressure, static pressure, and total temperature were obtained in the shear layers, and impact pressure and centerline static pressure data were measured in the recirculation zone. Author

N64-15986 Kyoto U. (Japan)
EFFECT OF SHOCK ATTENUATION ON REFLECTED SHOCK WAVES
G. Kamimoto, T. Akamatsu, and T. Hasegawa Oct. 1962 33 p refs
(CP-2)

It has been observed that the pressure behind the reflected shock waves in the shock tube increases with time at a fixed location. This phenomenon is caused by the nonuniformity in the free-stream gas behind the incident shock. This effect is calculated by linearized equations of characteristics and shock relations. The numerical results are compared with the observed ones. Author

N64-16070 Naval Ordnance Lab., White Oak, Md.
LAMINAR BOUNDARY LAYER CALCULATIONS BY FINITE DIFFERENCES
W. Parr Mar. 1964 22 p refs
(NOLTR-63-261; Math. Dept. Rept. M-42; AD-430776)

Calculation of the laminar boundary layer in axially symmetric flow by the use of finite differences is described. Discussed are the Prandtl differential equations, finite difference approximations, stability, convergence, starting procedures, and the gas assumptions. The principal advantage of finite differences is that no simplifying assumptions whatsoever are necessary. Author

N64-16096 Brown U., Providence, R.I.
THE VISCOSITY OF DRY AND HUMID AIR
J. Kestin and J. H. Whitelaw Jan. 1964 31 p refs Submitted for Publication
(Contract Nonr 3623(00); Proj. SQUID)
(TR-BRN-12-P; AD-429500)

The paper presents the results of new measurements on the viscosity of dry air along seven isotherms in the range 25° to 250° C and 1 to 140 atm, subject to an uncertainty of ±0.4%. The zero-density viscosity of dry air can be fitted within the experimental error by an interpolation formula based on the Lennard-Jones 6 to 12 potential. The apparent molecular constants that lead to a good fit differ considerably from those quoted in the literature. The effect of pressure can be accounted for, at least approximately, by adding a cubic polynomial function of density to the zero-density viscosity. This function, known as the excess viscosity $\Delta\mu$, is independent of temperature, certainly in the range 25° to 100° C. The paper also presents measurements of the viscosity of mixtures of air and water vapor. These are restricted to a nominal pressure of 1 atm and cover a range of molar fractions from zero to 0.03 at 25° C and zero to unity at 250° C. Measurements have been performed along the six isotherms 25°, 50°, 75°, 150°, 200°, and 250° C. Author

N64-16097 Aerospace Corp., El Segundo, Calif. Plasma Research Lab.
GENERAL RESEARCH: ON THE OSCILLATIONS OF A TURBULENT FLOW
W. O. Criminale (Princeton U.) 27 Jan. 1964 82 p refs
(ATN-64(9231)-1; AD-429174)

A turbulent boundary layer is assimilated to a laminar layer of large and variable viscosity. This viscosity represents the eddy viscosity. A stability analysis is performed for small perturbations by the use of a digital computer. It is found that a typical turbulent layer is stable, even if the eddy viscosity vanishes at the wall. However, if the mean velocity profile has a weak inflection near the outer edge, instabilities do occur. Various observations of the intermittent part of the layer suggest the existence of such inflections and lead to acceptable values of the wavelengths and phase velocities. It is also found that the laminar sublayer has a negligible effect on this type of oscillation. Author

12 GEOPHYSICS

Includes auroral phenomena; upper atmosphere studies; oceanography; cartography; geodesy; and geomagnetism. *For Van Allen belts see*: 28 Space Radiation. *For related information see*: 05 Astronomy and Astrophysics; 21 Meteorology; and 29 Space Sciences.

N64-15084 New York U., N.Y.
RESEARCH ON PHYSICS OF THE IONOSPHERE Final Report
Sidney Borowitz 30 Nov. 1963 11 p refs
(Contract AF 19(604)-4555)
(AFCRL-63-925; AD-428963)

Research on the physics of the ionosphere consisted of a general investigation of the structure of electron systems and the scattering problems involving principally multichannel processes. The three aspects of the atomic structure problem investigated were: (1) the elaboration of an idea of Pluvinage that takes as the unperturbed wave function the solution of the separable part of the Hamiltonian in the coordinates r_i and r_{ij}, and considers the cross derivatives the perturbations; (2) the electrons moving in the Thomas–Fermi field of the ion, and (3) a derivation of the Thomas–Fermi model of the ion atom starting with the many-body Schrödinger equation. Bounds were obtained on the scattering phase shifts in potential and multichannel scattering processes. It was also discovered that the effective range formula is different when there is a long-range and a short-range potential; these results were applied to the analysis of electron–rare-gas-atom cross section at zero energy. R.T.K.

N64-15088 Southwestern Coll., Memphis, Tenn.
ATMOSPHERIC TRANSMISSION IN THE INFRARED USING AN EXTRA-TERRESTRIAL SOURCE
J. H. Taylor *In its* Time-Dependent Infrared Studies Dec. 1963 p 129–228 refs (See N64-15085 07-01)

A Perkin–Elmer Model 112 (double pass) spectrometer was used to study solar spectra as a function of zenith angle of the sun. The spectrometer was equipped with a sodium chloride prism and a thermistor bolometer detector. Author

N64-15155 Iowa State U., Iowa City
HIGH-LATITUDE GEOPHYSICAL STUDIES WITH SATELLITE INJUN 3. [PART] 4: AURORAS AND THEIR EXCITATION
B. J. O'Brien (Rice U.) and H. Taylor Repr. from J. of Geophys. Res., v. 69, no. 1, Jan. 1964 p 45–63 refs (See N64-13059 04-12)
(NASA Grant NsG-233-62)

Photometric observations of auroras were made with the satellite Injun 3 at altitudes of 250 km to about 600 km. The magnetically oriented satellite simultaneously observed the precipitated electrons that caused the aurora and trapped electrons. The auroral zone, as defined on some 50 latitude surveys of the brightness of the N_2^+ emission at 3914 Å, showed an average maximum brightness of about 2 kilorayleighs at an invariant latitide (Λ) around 69° on the magnetic shell $L = 7.8$. Several visible auroras are discussed in detail. It is suggested that the auroras delineated the outer edge of the region of durable trapping of Van Allen electrons, and that the electrons causing the auroras and having an isotropic

angular distribution over the upper hemisphere at the satellite altitude were mostly freshly accelerated rather than old electrons of the Van Allen belts with similar energy. Author

N64-15171 Gt. Brit. Dept. of Scientific and Industrial Research
HEIGHT DISTRIBUTION OF ELECTRON CONCENTRATION IN THE TOPSIDE IONOSPHERE AS DEDUCED FROM TOPSIDE SOUNDER SATELLITE IONOGRAMS, VOLUME I
Dec. 1963 119 p

The results of the reduction of topside sounder ionograms (recorded by the Singapore satellite-data-acquisition station [1° N 104° E]) to real-height electron distributions are presented. The following information is presented for each reduction: (1) date of pass; (2) satellite revolution number; (3) frame number; (4) universal time at which the sounder frequency was 2.0 mc/s given in hours, minutes, and seconds; (5) geographic longitude and latitude in degrees and tenths of degrees; (6) a table containing the electron concentration at 10-km intervals of real height; and (7) a plot of electron concentration against geopotential height above ground. P.V.E.

N64-15184* California U., Los Angeles Inst. of Geophysics and Planetary Physics
THE ESCAPE OF HELIUM FROM THE EARTH'S ATMOSPHERE
Gordon J. F. Mac Donald *In its* Notes for the Summer Inst. in Planetary Phys. 1963 97 p refs (See N64-15182 07-01) OTS: $21.00 ph, $11.03 mf

This paper is concerned with an examination of possible changes in the escape rate due to variations in the earth's magnetic field. Problems associated with the heat balance in the upper atmosphere are reviewed. It is considered likely that a heat source over and beyond that provided by ultraviolet radiation is required to account for the day–night variations in upper atmosphere densities. Various mechanisms by which energy density in the solar wind can be transferred into the upper atmosphere are considered. If the additional heat source is due to the solar plasma, historical fluctuations in the earth's magnetic field could result in a greater escape rate of helium. The establishment and identification of the additional heat source is necessary for a full understanding of the escape of helium. The terrestrial economy of helium 3 is reviewed. Author

N64-15218* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AN ANALYTICAL STUDY OF THE MAGNETIC FIELD ENCOUNTERED BY ARTIFICIAL EARTH SATELLITES IN CIRCULAR ORBITS
Ward F. Hodge and W. Thomas Blackshear Washington, NASA, Feb. 1964 49 p refs
(NASA TN D-2041) OTS: $1.25

Analytical procedures for determining the magnetic field along the satellite orbit for any day in the year are developed on both an average and an instantaneous time basis. These methods are of interest in evaluating magnetic attitude-control schemes, since the information they provide determines the magnitude and direction of the magnetic torque exerted on the satellite by the interaction of an onboard magnet with the earth's magnetic field. The equations and methods presented are considered adequate for applications requiring attitude control within a few degrees. To illustrate typical results, plots of the average and instantaneous magnetic fields calculated from the equations are presented for seven orbital inclinations ranging from 0° to 90° at orbital altitudes of 100, 300, and 500 nautical miles. These results show that the regression of the nodes of the satellite orbit has an effect that cannot be neglected. Author

N64-15244 Minneapolis-Honeywell Regulator Co., Minn. Military Products Group
THE QUESTION ON THE DETERMINATION OF THE ABSOLUTE VALUE OF THE GRAVITY
N. P. Grushinskii and N. B. Sazhina [1962] 15 p refs Transl. into ENGLISH from Vestn. Mosk. Univ. Astron. (Moscow), no. 2, 1959 p 61–68
(MH-Transl. 342)

A short survey of gravimetric methods is presented. The differences between the three existing absolute values for the acceleration of gravity are also discussed. P.V.E.

N64-15279 Naval Observatory, Washington, D.C.
UPPER ATMOSPHERE PHYSICS
Edward O. Hulburt *In* Georgetown U., Washington, D.C. Recent Advances in Astro-Geophysics [1961] p 13–20 (See N64-15276 07-01)

The topics discussed include the following properties of the upper atmosphere: (1) temperature; (2) chemical composition; (3) wind mixing; (4) albedo; (5) the night airglow; (6) the ionization of the ionosphere—D-region, E-region, and F_1- and F_2-regions; (7) aurorae; and (8) magnetic storms. R.T.K.

N64-15280 National Aeronautics and Space Administration, Washington, D.C.
GEODETIC APPLICATIONS OF SATELLITE TRACKING
John A. O'Keefe *In* Georgetown U., Washington, D.C. Recent Advances in Astro-Geophysics [1961] p 21–28 (See N64-15276 07-01)

Results that have been obtained by the study of artificial satellites, which have a special value for the understanding of the earth's interior, are presented. The measurements of the harmonics of the earth's gravitational field give information concerning the strength of the earth's interior, and this information permits a distinction to be made between the two principal theories of the nature of the earth's mantle and the formation of the mountains. R.T.K.

N64-15282 Georgetown U., Washington, D.C.
BACKSCATTER TECHNIQUES IN GEOPHYSICS
W. J. Thaler *In its* Recent Advances in Astro-Geophysics [1961] p 39–47 (See N64-15276 07-01)

The general characteristics of radio-wave propagation are reviewed. Solar ultraviolet and high-frequency electromagnetic radiation are discussed as they are the chief sources of atmospheric ionization. Meteors entering the earth's atmosphere also produce ionization. The mathematical basis and the technique of vertical ionospheric sounding that are widely used to study the earth's ionosphere and its perturbations are presented. R.T.K.

N64-15291 Georgetown U., Washington, D.C.
THE ORIGIN AND ABUNDANCE OF THE ELEMENTS
Wallace R. Brode *In its* Recent Advances in Astro-Geophysics [1961] p 111–116 refs (See N64-15276 07-01)

The use of the emission and absorption spectra from celestial bodies for obtaining information concerning these bodies, such as the speed of motion, direction of rotation, temperature, and other physical properties, is discussed. The spectra also provide clues as to the chemical composition and relative abundance of elements. The relative abundance of elements on the earth has been difficult to determine. Due to the natural separations resulting from reactions, solubilities, and disintegration, the earth's crust does not contain the same composition as the interior, because the earth's density, as demonstrated by gravitational force and known diameter, is much greater than the average density of the crust. The

usual method of chemical analysis has provided a fairly precise determination of the earth's average composition. The abundance of elements in the universe can be predicted through: (1) extrapolation of the earth's composition, (2) analysis of meteorites; and (3) observation of spectra. R.T.K.

N64-15295 International Council of Scientific Unions, Paris (France)
IQSY INSTRUCTION MANUAL FOR WORLD DAYS PROGRAM, NO. 1
A. H. Shapley (CRPL-NBS) London, CIG-IQSY Comm., Jul. 1963 43 p refs

The World Days program for the International Years of the Quiet Sun (IQSY) provides the framework for coordination of many aspects of the scientific programs recommended for each of the IQSY disciplines—meteorology, geomagnetism, aurora, airglow, ionosphere, solar activity, and cosmic rays and aeronomy, including programs carried on from the ground and in rockets and satellites. The details of these programs call for special observational effort on certain days during IQSY or for special treatment of the results of the observations. These particular days are known as "World Days." This manual for the World Days program for the International Years of the Quiet Sun includes the following: (1) a description of the IQSY World Days program; (2) a listing of scientific programs recommended for World Days and Intervals; (3) a description of the communications arrangements; (4) a description of the functions of warning centers and warning contacts; (5) information on synoptic codes; and (6) addresses and detailed data concerning participating agencies and centers. P.V.E.

N64-15304* Iowa State U., Iowa City
HIGH-LATITUDE GEOPHYSICAL STUDIES WITH SATELLITE INJUN 3. PRECIPITATION OF ELECTRONS INTO THE ATMOSPHERE
B. J. O'Brien Repr. from J. Geophys. Res., v. 69, no. 1, 1 Jan. 1964 p 13–43 refs (See N64-13059 04-28)
(NASA Grant NsG-233-62; Contract Nonr-93803)

It is shown that the intensity of electrons mirroring at the satellite altitude increases rather than decreases when precipitation occurs, for example, over an aurora. The precipitation process is such that the angular distribution of electrons tends to approach isotropy over the upper hemisphere at the satellite altitude. The flux of electrons with $E_e \geq 40$ kev backscattered by the atmosphere is about 10 percent of the precipitated flux. No events have been found where the upflux exceeded the downflux, and it is concluded that most acceleration processes take place high above the satellite, accelerating electrons preferentially parallel to the magnetic field lines. It is shown that electrons with $E_e \geq 1$ Mev trapped around $L \sim 4$ are not perturbed when electrons with $E_e \geq 40$ kev are precipitated at the same place, and so it is considered that the precipitation is not caused just by a gross change in the magnetic field producing lowered mirror points. Author

N64-15306* New York U., N.Y.
FAST-NEUTRON FLUX IN THE ATMOSPHERE
R. B. Mendell and S. A. Korff Repr. from J. Geophys. Res. v. 68, no. 19, 1 Oct. 1963 p 5487–5495 refs
(NASA Grant NsG-167-61)
(NASA CR-55374)

A fast-neutron detector was carried by balloon up to 27.4 km. The detector consisted of an inner liquid scintillator, employing pulse-shape discrimination, and a thin 4π phosphor shield for rejection of charged particles. Both scintillators were viewed by a single photomultiplier. The counting rates produced by neutrons in two energy intervals between 1 and 10 Mev were recorded. The best fit to a power law spectrum was $N(E)dE = 2.6E^{-1.16\pm0.2}\exp(-0.0069x)dE$ neutrons/cm^2 sec Mev in the equilibrium region. The counting rate rose to a broad maximum at about 75 g/cm^2, where the total flux of neutrons between 1 and 10 Mev was 1.9 neutrons/cm^2 sec. The flux at floating altitude was 1.4 neutrons/cm^2 sec. Author

N64-15358 State University of New York at Buffalo Natural Sciences Inst.
RESEARCH SUPPORT FOR 1963 SUMMER FIELD OPERATIONS OF ATMOSPHERIC PHYSICS SECTION OF U.S. ARMY ELECTRONICS RESEARCH AND DEVELOPMENT LABORATORY Final Report
Vincent J. Schaefer 15 Sep. 1963 17 p
(AROD-45691; AD-429546)

The status of the following areas is presented: (1) infrared studies; (2) condensation nuclei studies; (3) lightning studies; (4) storm-monitoring with the raindrop camera; and (5) wind studies. Also, papers are presented, in the appendix, on: (1) "The Diurnal Temperature Pattern of the Bonito Lava Flow," and (2) "Measurements of Condensation Nuclei near Flagstaff, Arizona, in the Vicinity of the San Francisco Peaks." I.v.L.

N64-15412 Joint Publications Research Service, Washington, D.C.
PRINCIPLES OF ELECTRICAL EXPLORATION
A. G. Tarkhov, ed. 12 Feb. 1964 74 p ref Transl. into ENGLISH of 4 sect. from the book "Spravochnik Geofizika, Vol. 3: Elektrorazvedka" Moscow, 1963 p 75–93, 311–329, 345–348, and 381–398
(JPRS-23207; OTS-64-21549) OTS: $2.00

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N64-15414 Joint Publications Research Service, Washington, D.C.
AIRBORNE ELECTRICAL EXPLORATION
G. S. Frantov and Yu B. Shaub *In its* Principles on Elec. Exploration 12 Feb. 1964 p 24–47 ref (See N64-15412 07-12) OTS: $2.00

An infinitely long cable method and the induction method of airborne electrical exploration are described. Theoretical principles of the infinitely long cable method are given along with the work method, the processing of survey data, and the interpretation of results. The discussion of the induction method includes its principal variants and the determination of the secondary fields of a homogeneous conducting half-space in the presence of a magnetic dipole. The rotating magnetic-field method, which is accomplished by the use of tow aircraft, is also discussed along with a method for the measurement of the inclination of the polarization of a natural variable magnetic field. C.L.W.

N64-15415 Joint Publications Research Service, Washington, D.C.
PHYSICAL PRINCIPLES OF HIGH-FREQUENCY ELECTRICAL EXPLORATION

A. G. Tarkhov *In its* Principles on Elec. Exploration 12 Feb. 1964 p 48–64 (See N64-15412 07-12) OTS: $2.00

Consideration is given to the use of radio waves in geological investigations. The discussion covers the normal field of a radio transmitter, propagation of electromagnetic waves in rocks, and anomalous fields of geologic origin. C.L.W.

N64-15416 Joint Publications Research Service, Washington, D.C.

TYPES OF DEPOSITS FAVORABLE FOR EXPLORATION BY THE INDUCED POLARIZATION METHOD

In its Principles on Elec. Exploration 12 Feb. 1964 p 65–71 (See N64-15412 07-12) OTS: $2.00

Types of deposits, country rocks, and electron-conducting minerals are given. The volume content of electron-conducting minerals in ore is given in percentages, and the companion elements that are extracted from the ores are identified. C.L.W.

N64-15427 Centre National d'Etudes des Telecommunications (France) Ionospheric Predictions Div.

SUDDEN IONOSPHERIC DISTURBANCES. EFFECTS NOTED AND PROBABLE CAUSES [LES PERTURBATIONS IONOSPERIQUES A DEBUT BRUSQUE. EFFETS CONSTATES ET CAUSES PROBABLES]

Pierre Halley *In* Agard, Paris The Effect of Disturbances of Solar Origin on Commun. 1963 p 1–20 refs In FRENCH; ENGLISH summary (See N64-15426 07-08)

The sudden ionospheric disturbances (SIDs) are the geophysical result of certain solar chromospheric eruptions. The most serious effect to radio communications consists of an abnormal absorption of middle and short waves in the lower ionosphere. The fadeout time of these waves may last from several minutes to several hours. The HF circuits are attenuated in the entire sunlit hemisphere, and sometimes also the VHF forward scatter circuits. The propagation of long waves below about 300 kc is improved, especially in the 10 to 50 kc range. The abnormal ionization in the *D*- and lower *E*-regions is due mainly to soft X-rays, emitted during the flares as bremsstrahlung from fast electrons in the chromosphere. The height profile of the additional ionization, below and above 85 km, depends on the energy spectrum of the ionizing radiation, which varies from flare to flare. It follows from the study of ionspheric absorption that the ionization extends from below the 60-km level up to the *E*-layer maximum. The increase of cosmic radiation, exceptionally associated with certain very strong flares, can cause abnormal absorption of prolonged duration. Author

N64-15429 Arctic Inst. of North America, Washington, D.C.

IONOSPHERIC POLAR BLACKOUTS AND RADIO COMMUNICATION DISTURBANCES

Tatsuzo Obayashi *In* Agard, Paris The Effect of Disturbances of Solar Origin on Commun. 1963 p 37–45 refs (See N64-15426 07-08)

(NSF Grant 13840)

It is generally believed that HF radio communication disturbances have two principal origins—the depression of critical frequency of the *F*2-layer associated with geomagnetic disturbances, and the increase of absorption in the lower ionosphere due to enhanced X-ray radiation or the precipitation of energetic particles from outer space. In the polar region, radiowaves suffer very intense absorption occasionally, and they are then known as "polar blackouts." It is found that there are two types of polar blackout: one is produced by low-energy solar cosmic rays ejected from an intense solar flare, and the other is produced by auroral particles. The former is called the polar cap blackout because it is confined to the entire polar region, whereas the latter occurs mainly along the auroral zone. Some morphological studies of these polar blackouts are reviewed, and general characteristics of the worldwide development of disturbances are discussed in connection with radio communication problems. Author

N64-15430 Stanford U., Calif. Radioscience Lab.

THULE TO COLLEGE 12 Mc PROPAGATION DURING THE APRIL AND MAY 1960 INTENSE POLAR CAP ABSORPTION EVENTS

R. D. Egan *In* Agard, Paris The Effect of Disturbances of Solar Origin on Commun. 1963 p 47–58 refs (See N64-15426 07-08)

(Contract AF 19(604)-4103; NSF Grant y/6.12/62; NSF Grant y/22.10/309)

During a 7-month period, continuous signal-strength measurements of pulse signals from Thule, Greenland, were made at College, Alaska. A number of significant polar cap absorption events (type III) were recorded during April and May 1960, on riometer equipment operated by the Geophysical Institute of the University of Alaska. The spread of the polar cap absorption southward may be traced in successive drops of the 12 Mc signal strength on the Thule–College path. During these polar cap absorption events, cosmic noise absorption may exceed 10 db at 27 Mc at Thule and College. However, 12 Mc signals propagated from Thule have been received continuously at College with only 35 db attenuation during the peak of the absorption. These observations indicate that the attenuation does not obey an inverse frequency-squared law and that the attenuation reaches a surprisingly low maximum value shortly after the beginning of a polar cap absorption event. After reaching this maximum value, the absorption remains essentially constant throughout the event. Author

N64-15435 Deutsche Bundespost, Breisach (W. Germany) Ionosphere Inst.

COMPARISON OF SOLAR FLARE EFFECTS IN THE D AND E REGION OF THE IONOSPHERE

K. Bibl *In* Agard, Paris The Effect of Disturbances of Solar Origin on Commun. 1963 p 109–118 refs (See N64-15426 07-08)

It can be shown that the different enhancement of ionization in the ionospheric *D*- and *E*-regions is due to different kinds of solar radiation. An attempt is presented to find a one-dimensional parameter $\delta'' f_o E_{max}$ indicative for the energy distribution on the solar spectrum that is independent of strength and time of the event. With the help of the new technique of continuously recorded ionospheric parameters and of an automatic warning system, every ionospheric event can be detected, and misinterpretations can be avoided. Only very narrow solar latitude spheres are responsible for the ionospheric effectiveness of flares. Author

N64-15436 National Bureau of Standards, Boulder, Colo. Central Radio Propagation Lab.

A STUDY OF F2 LAYER EFFECTS AS OBSERVED WITH A DOPPLER TECHNIQUE

K. Davies, J. M. Watts, and D. H. Zacharisen *In* Agard, Paris The Effect of Disturbances of Solar Origin on Commun. 1963 p 119–133 refs (See N64-15426 07-08)

(USIA Agreement IA-6809)

Changes in the height and shape of the ionosphere produce variations in the frequency, at a receiver, of waves emitted from a stable sender. WWV-10, WWV-15, WWV-20, and WWVH-10 have been recorded at Boulder on slow-moving magnetic tape. By rapid playback, the Doppler frequency is converted into an audiofrequency, and the spectrum is analyzed by conventional techniques. Records obtained by this

technique are presented to illustrate the phenomena observed during magnetically quiet and disturbed periods. Experimental effects associated with solar flares and magnetic sudden commencements are presented. The frequency dependence of the frequency variations is shown to give information concerning the height location of the associated ionospheric effects. Author

N64-15437 Centre National d'Etudes des Telecommunications (France)
A STUDY ON THE INFLUENCE OF TYPE IV SOLAR FLARES ON THE WORLD-WIDE IONOSPHERIC ABSORPTION [ETUDE DE L'INFLUENCE DES ERUPTIONS SOLAIRES DE TYPE IV SUR L'ABSORPTION IONOSPHERIQUE MONDIALE]
D. Lepechinsky and C. Dovoust *In* Agard, Paris The Effect of Disturbances of Solar Origin on Commun. 1963 p 135–142 refs FRENCH; ENGLISH summary (See N64-15426 07-08)

The effects of solar chromospheric flares on region *D* of the ionosphere, where certain types of flares produce a sudden increase of ionization and of radio waves absorption (SIDs), have been examined. The present investigation covers the period from April 1957 up to the end of 1959 and has led to the following conclusions: (1) In practice, only those flares associated with type IV radio-outbursts (giving rise to centimetric and metric wave enhancements) are effective in producing anomalous ionospheric absorption. (2) The magnitude of the ionospheric absorption is in direct relationship with the intensity of the solar radio-outburst and with its duration on centimetric waves. (3) The anomalous absorption decreases rapidly with the distance from the subsolar point, in the vicinity of which complete blackouts are thus often observed. The last two conclusions are drawn from the analysis of 11 events selected during the IGY period. Corresponding maps have been drawn showing the value of the fmin at different stations and their respective distances from the subsolar point. Author

N64-15438 Centro Radioelettrico Sperimentale G. Marconi, Rome (Italy)
BACKSCATTER SOUNDING DURING IONOSPHERIC STORMS
I. Ranzi and P. Dominici *In* Agard, Paris The Effect of Disturbances of Solar Origin on Commun. 1963 p 143–154 refs (See N64-15426 07-08)
(Contract AF 61(052)-139)

The results of the ionospheric backscatter soundings carried out at Torrechiaruccia during some severe ionospheric storms from August 1957 to February 1961 are briefly discussed. The advantages of the backscatter soundings for studying the morphology of an ionospheric storm over a large area are put in evidence. The observed displacement of the perturbed zone may be explained as the result of the superposition of the D_{st} and S_D storm components. During an ionospheric storm, the echoes from the nondisturbed zone show a stronger intensity and a wider extent than during normal conditions. Author

N64-15439 Stanford U., Calif. Radioscience Lab.
THE INFLUENCE OF SUDDEN IONOSPHERIC DISTURBANCES ON BACKSCATTER SOUNDING
R. D. Egan and A. M. Peterson *In* Agard, Paris The Effect of Disturbances of Solar Origin on Commun. 1963 p 155–165 refs (See N64-15426 07-08)
(NSF Grant Y/22.10/309; NSF Grant Y/6.12/62)

Analysis of the IGY three-frequency backscatter records during sudden ionospheric disturbances (SID) has revealed some interesting and unexpected behavior. The majority of the SIDs produce expected effects on the backscatter echoes. The multiple hops disappear shortly after the SID onset and are followed by the disappearance of all echoes during the period of maximum absorption. During the recovery phase of the SID, there is a slow recovery of backscatter echoes back to normal. In most cases no change in the skip distance (or MUF) occurs during the SID. However, in a number of cases a distinct range increase of more than 500 km in the first hop skip distance has occurred. Thus, the MUF has been decreased, requiring a decrease in operating frequency, contrary to the more normal procedure of increasing frequency or awaiting the end of the SID. Long-distance high-frequency propagation-circuit data and riometer records for the same events are compared with the backscatter observations. Author

N64-15440 National Bureau of Standards, Boulder, Colo.
EFFECTS OF MAGNETIC DISTURBANCE AS NOTED ON OBLIQUE-INCIDENCE IONOGRAMS
V. Agy and K. Davies *In* Agard, Paris The Effects of Disturbances of Solar Origin on Commun. 1963 p 167–176 refs (See N64-15426 07-08)

Over the period 1951 to 1958, the sweep-frequency pulse technique was used to study high-frequency radio propagation over two east–west paths—Washington to St. Louis (1,150 km) and Washington to Boulder (2,370 km). Some ionograms observed during magnetic disturbances are presented and are compared with the quiet ionograms. The behavior of the maximum observed frequency and of the minimum observed frequency is also discussed. Author

N64-15442 Page Communications Engineers, Inc., Washington, D.C.
SOLAR-INDUCED EFFECTS OF VHF IONOSPHERIC PROPAGATION AT LOW MAGNETIC LATITUDES
Walter F. Bain *In* Agard, Paris The Effect of Disturbances of Solar Origin on Commun. 1963 p 185–192 refs (See N64-15426 07-08)
(Contract DA 36-039-SC-66372)

Signal-intensity behavior on the Pacific scatter circuits has been briefly examined during periods of both moderate and severe ionospheric storminess and during relatively small magnetic fluctuations, such as a magnetic bay. Although HF circuits either failed or experienced substantial degradation during severe ionospheric disturbances, the VHF turbulent-scatter mode was virtually unaffected. However, it may be concluded that the strong field-aligned daylight component present on the equatorial circuits is rapidly and adversely affected by even small magnetic events. The remaining turbulent-scatter signal intensities on these circuits appear unaffected, as do the signals on the circuits showing turbulent scatter only. Even during extremely severe disturbances, the turbulent scatter component showed no deterioration other than momentary drops during severe HF SWFs. Author

N64-15448 Air Force Cambridge Research Labs., Bedford, Mass. Electronics Research Directorate
A YEAR'S STUDY OF THE INDEX OF IONOSPHERIC STORMINESS
H. S. Marsh, R. J. Cormier, R. A. Swirbalus, W. H. Cameron, and R. S. Murphy *In* Agard, Paris The Effect of Disturbances of Solar Origin on Commun. 1963 p 261–286 refs (See N64-15426 07-08)

By comparison of disturbed days with monthly quiet day averages, indices of storm contraction of the useful path spectrum, of MUF and LUF deviations, and MUF/LUF index showing whether spectrum damage is mainly due to MUF or LUF deviation are found. These indices for each day are compared with Fort Belvoir f_0F2 and Fredrickburg A_k variations, and strong correlation is found. Monthly and seasonal trends of A_k and Storm Index intensities are established and discussed. Au

empiric law relating A_k intensity to same-day Storm Index, or spectrum damage, is established. It takes the form of a hyperbolic spiral. Considering the magnetic disturbance as a shock-pulse, and consequent Storm Index variations as a resultant damped oscillation lasting for several days, the rate of magnetic disturbance growth and decay is shown to be related clearly with one of several typical forms, or "spectra," of Storm Index morphology. Author

N64-15667 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DETERMINATION OF THE EARTH'S GRAVITATIONAL FIELD
William M. Kaula Repr. from Rev. Geophys., vol. 1, no. 4, Nov. 1963 p 507–551 refs
(NASA RP-132)

In all three principal methods of measuring the earth's gravitational field—gravimetry, satellite orbit perturbations, and astrogeodetic networks—both mathematical theory and observational techniques have been developed in recent years to more than sufficient accuracy to define and determine the irregularities of the field significant on a planetary scale. The common defect of all three methods is inadequate distribution of observations. At present, the different methods agree only for major features, such as the Indian Ocean minimum; the normalized spherical harmonic coefficients of the potential C_{nm}, S_{nm} are known to be of an order of magnitude of about $\pm 1.3 \times 10^{-6}/(n-1)$ with an uncertainty of about $\pm 0.6 \times 10^{-6}$ for the tesseral terms. Gradual improvement is anticipated with additional observations and the application of better statistical techniques made possible by modern computers. Author

N64-15865* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ON THE HEIGHT OF AURORAL ABSORPTION
Bengt Hultqvist Dec. 1963 22 p refs
(NASA TM X 54567; X-611-63-257) OTS: $2.60 ph, $0.86 mf

The height distribution of absorption produced by two different observed electron spectra, $N(E)dE = 5.10^9 \exp(-E/5)\,dE$ and $N(E)\,dE = 7.10^4 \exp(-E/41)\,dE$, and also by the bremsstrahlung from the first-mentioned electron spectrum, has been estimated. The results indicate that the absorption in the 60 to 90 km range, due to hard electron spectra, often may dominate, whereas the absorption caused by bremsstrahlung is smaller than that due to the primary electrons producing the X-rays. These results are discussed in respect to the height of the absorbing layer and the observed very small variation of auroral absorption at sunrise and sunset. Author

N64-15927 Joint Publications Research Service, Washington, D.C.
METHOD OF UNDERWATER DETECTION BASED ON THE USE OF MAGNETIC AND ELECTRICAL PHENOMENA
A. N. Bessonov et al 3 Mar. 1964 38 p Transl. into ENGLISH of Ch. I of the book "Podvodnyy poisk" Moscow, Publishing House of the Min. of Defense, 1963 p 6–47
(JPRS-23491; OTS-64-21703) OTS: $1.00

The following topics are discussed: (1) the earth's magnetic field; (2) the magnetic field of ferromagnetic bodies and their interaction with the earth's magnetic field; (3) the formation and radiation of an electromagnetic field; (4) searching for ferromagnetic objects using magnetically saturated sounding; (5) methods of detecting ferromagnetic objects based on the principle of free nuclear precession; and (6) electromagnetic methods of detecting underwater objects. R.T.K.

N64-15938 Avco-Everett Research Lab., Everett, Mass.
AERODYNAMIC ASPECTS OF THE MAGNETOSPHERIC FLOW
R. H. Levy, H. E. Petschek, and G. L. Siscoe (Mass. Inst. of Tech.) Dec. 1963 27 p refs
(Contract Nonr-2524(00))
(Avco-Everett Res. Rept.-170; AD-430410)

Numerous phenomena observed at the surface of the earth, in the magnetospheric cavity, and in the neighborhood of its boundary are related to the flow of the solar wind. The extent to which this flow can be analyzed by the techniques of continuum fluid mechanics is discussed in relation to the observational and theoretical evidence. Observations of auroral motions and alignments have indicated that flow patterns with appreciable velocities exist inside the magnetosphere, thus suggesting appreciable coupling across the boundary. Analysis of such a boundary leads to a rate of reconnection of the field lines that decreases only logarithmically with the magnetic Reynolds number. The logarithmic dependence implies a rapid rate of reconnection, which fortunately is very insensitive to the uncertainties in the effective conductivity of the plasma. Applying this result to the flow over the magnetosphere, it is concluded that more than 10% of the magnetic field lines brought to the surface of the magnetosphere by the solar wind get broken and reconnected to the earth's polar field lines. Author

N64-15952 Pennsylvania State U., University Park Ionosphere Research Lab.
Final Report for Period: PART A: April 1, 1961 to March 31, 1963; PART B: July 1, 1961 to July 31, 1963 [LOW FREQUENCY IONOSONDE INVESTIGATIONS AND ROCKET MEASUREMENTS IN THE D-REGION AND LOWER E-REGION]
A. J. Ferraro and J. S. Nisbet 31 Aug. 1963 47 p refs
(Contract AF 19(604)-8012)
(AFCRL-63-924; AD-429187)

Research was directed toward the investigation of the structure and variations of the lower ionosphere by extending the normal ionosonde sweep frequency technique into the low-frequency range and investigation of ionospheric parameters by means of a conductivity rocket probe. The problems outlined fit under the broad categories of recording programs, electromagnetic theory studies, ionospheric phenomena, ground based and rocket equipment development, and the physics of ionospheric formation. Author

N64-15970* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
AN ANALYSIS OF TIROS II RADIATION DATA RECORDED OVER NEW ZEALAND AT NIGHT
Lewis J. Allison Washington, NASA, Mar. 1964 21 p refs
(NASA TN D-1910) OTS: $0.75

Infrared radiation measurements in the 8μ to 12μ, 8μ to 30μ, and 6.0μ to 6.5μ wavelength regions taken by Tiros II on its initial orbit over New Zealand are examined in detail. A subjective analysis of the synoptic situation confirmed the two broad-scale frontal systems that were clearly outlined by the Tiros II radiation data recorded over the Tasman Sea at night. The equivalent blackbody temperatures measured in the 8μ to 12μ region were found to be 6° to 12° K colder than the sea water temperatures in warm radiation source areas. In the 6.0μ to 6.5μ region the equivalent blackbody temperatures, when converted to "effective radiation height" averaged 8705 feet below the tropopause at five upper air stations. Author

N64-15977 Minnesota U., Minneapolis Cosmic Ray Group
ELECTRON DENSITY PROFILES IN THE LOWER IONOSPHERE DUE TO SOLAR COSMIC RAYS

W. R. Webber and P. S. Freier Repr. from J. Geophys. Res., v. 68, no. 23, 1 Dec. 1963 p 6223–6228 refs
(NASA Grant NsG-281-62)
(CR-68)

The ionospheric electron-density profiles recently measured by multiple-frequency radio-absorption technique are compared with those profiles deduced from particle measurements at balloon altitudes. The electron densities predicted on the basis of the ionospheric parameters and exponential rigidity spectrums of Freier and Webber agree well with the measured profiles. The use of Kane's revised values for the collision frequency, along with the predicted electron densities, give absorptions somewhat smaller than measured values for some solar events. The contribution of solar α particles to the electron densities should be included to resolve the discrepancy. Author

N64-15981 Lockheed Missiles and Space Co., Sunnyvale, Calif.
WIND WAVES AND SEA SLOPE MEASUREMENT: AN ANNOTATED BIBLIOGRAPHY [1948–JUN. 1963]
Peter R. Stromer, comp. Jul. 1963 61 p refs
(SRB-63-4; Rept. 6-90-63-78)

This bibliography cites 134 references on the related subjects of wind waves and sea slope measurement. Oceanographic measurements reported in the bibliography have emphasized optical techniques and light transmission in sea water. The period of literature coverage is from 1948 through June 1963. A subject index is included. Author

N64-15983 Weapons Research Establishment (Australia)
IONOSPHERIC DATA FOR JUNE, 1963 FROM WOOMERA, SOUTH AUSTRALIA
Dec. 1963 25 p
(CPD-1963/6(W))

Tables of hourly values of the customary ionospheric parameters are given for the station at Woomera for June 1963. Author

N64-15984 Weapons Research Establishment (Australia)
IONOSPHERIC DATA FOR JULY, 1963 FROM WOOMERA, SOUTH AUSTRALIA
Dec. 1963 24 p
(CPD-1963/7(W))

Tables of hourly values of the customary ionospheric parameters are given for the station at Woomera for July 1963. Author

N64-16005* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ON THE HEATING OF THE POLAR UPPER ATMOSPHERE
Kaichi Maeda Washington, NASA, Dec. 1962 66 p refs
(Supported in part by NSF Grant G-13999)
(NASA TR R-141) OTS: $1.75

On the basis of the atmospheric composition given by F. S. Johnson, the contribution of auroral particles to the dissociation of oxygen molecules in the polar upper atmosphere is investigated. The maximum rate coefficients are 4×10^{-8} $(cm^3\ sec)^{-1}$ and 2×10^{-8} $(cm^3\ sec)^{-1}$ for protons of energy spectrum $E^{-2.9}\ dE$ and for electrons of energy spectrum $E^{-4}\ dE$, respectively. The height of maximum dissociation is around 90 km both for protons and electrons. The heating of the polar mesosphere by exothermic association of the oxygen atoms, intensified by the subsidence of the upper polar atmosphere during the polar night, is calculated and found to be close to the estimate given by W. W. Kellogg. The investigation indicates, however, that Kellogg's estimate should be reduced slightly to allow for the cooling effect produced by far infrared emission from atomic oxygen in the upper atmosphere. Author

N64-16006* National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
SPECTRUM OF HYDROMAGNETIC WAVES IN THE EXOSPHERE
Gordon J. F. Mac Donald Washington, NASA, Dec. 1962 62 p refs
(NASA TR R-143) OTS: $1.75

A disturbance in the exosphere generates waves in three partially separable modes. These modes are described by considering the vorticity about a line of force, the two-dimensional divergence of velocity in the plane perpendicular to the line of force, and the component of velocity along the line of force. The propagation of vorticity is one-dimensional, and there is no geometrical attenuation; energy is lost only through the finite conductivity of the medium. The propagation of the longitudinal velocity component is almost one-dimensional but is heavily damped at high frequencies. In a gravitational field the medium is no longer uniform, and at low frequencies the modes are coupled in a complicated way. For parallel magnetic and gravitational fields, the vorticity mode is still separable, and gravity leads to anisotropic dispersion in the other modes. Author

N64-16028* Geophysics Corp. of America, Bedford, Mass.
PLANETARY PHYSICS II: LABORATORY STUDIES OF THE CHEMILUMINESCENCE FROM THE ATOMIC OXYGEN-NITRIC OXIDE REACTION UNDER UPPER ATMOSPHERIC CONDITIONS
N. Jonathan and G. Doherty Jan. 1964 32 p refs Prepared for presentation at Faraday Soc. Meeting, Edinburgh, Scotland Apr. 2–3, 1964
(NASA Contract NASw-840)
(NASA CR-55805; GCA-TR-64-2-N) OTS: $3.60 ph, $1.16 mf

The following main conclusions are derived: (1) The atomic oxygen–nitric oxide reaction is a three-body process down to pressures of at least 1 micron. (2) The light-emitting reaction is not pressure dependent, and, hence, the existing rate constant for light emission of 1.7×10^{-17} cc $molecule^{-1}$ sec^{-1} may be applied at total pressures as low as 1 micron. (3) Provided that nitric oxide is present in concentrations of 10^8 molecules/cc over the altitude range 80 to 110 km, there should be sufficient light emitted to make the atomic oxygen-nitric oxide reaction a prime contributor to the nighttime airglow continuum. Author

N64-16048 RAND Corp., Santa Monica, Calif.
HYDROMAGNETIC SIGNALS IN THE IONOSPHERE
E. C. Field Sep. 1963 54 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-3830-PR; AD-421842)

The equations that govern the propagation of hydromagnetic signals in a spatially inhomogeneous, multispecies, anisotropic ionosphere are derived and applied to several situations. Numerical results for the dependence of the ionospheric refractive indices on height and signal frequency are presented and discussed. Simplified model ionospheres, characterized by the refractive indices, are used to compute the ground-level magnetic signals produced by hydromagnetic waves incident normally from above, upon the collision-dominated lower ionosphere. Magnetic disturbances, which were observed at great distances from the high-altitude Argus nuclear explosions, are considered and are shown to have been probably hydromagnetic in origin. Author

N64-16073 Queen's U., Belfast (Northern Ireland)
A SEA-LEVEL PHOTOGRAPHIC OBSERVATION OF THE DAY AIRGLOW EMISSION OF ATOMIC OXYGEN AT 6300 A
A. H. Jarrett and M. J. Hoey [1963] 7 p refs
(AF Grant EOAR-63-85)
(AFCRL-64-220; AD-430706)

A single-plate 2.5-cm-aperture Fabry–Perot interferometer was used in the observations. Several exposures of five seconds' duration with the equipment directed to the zenith were made around 1500 G.M.T. from Belfast, the solar zenith distance being approximately 55°. By examining the film and by comparing it with twilight exposures, it was possible to estimate the intensity. A value of between 30 and 40 kilorayleighs is inferred for the 6,300 A dayglow. E.W.

N64-16081 Raytheon Co., Norwood, Mass.
INVESTIGATION OF ELECTRICAL CHARACTERISTICS OF ROCK MEDIUM ON CAPE COD Scientific Report No. 1
Carson K. H. Tsao Dec. 1963 51 p refs
(Contract AF 19(628)-2362)
(AFCRL-64-1; AD-430719)

Experiments were conducted on Cape Cod, Massachusetts, to investigate electrical characteristics of subsurface rock strata and various techniques related to rock-propagated radio signals. Electrically short dipoles were placed in drill holes to determine the conductivities of the rock media surrounding the drill holes and the attenuation by the overburden of distant VLF signals traveling through it from the surface of the ground to the rock. Propagation tests were made between antennas placed in two drill holes separated by a distance of 1 mile. By assuming the rock to be a semi-infinite medium and the overburden to be a perfect ground plane, the attenuation and phase constants of the rock medium were deduced independently and used to obtain the bulk conductivity along the path.
Author

N64-16099 Library of Congress, Washington, D.C. Aerospace Information Div.
PHENOMENA IN THE UPPER ATMOSPHERE. COMPILATION OF ABSTRACTS FROM SOVIET-BLOC LITERATURE
12 Feb. 1964 17 p refs
(Rept.-39; AID-P-64-10; AD-430822) OTS: $1.60 ph, $0.80 mf

Information is compiled concerning ionospheric electron concentrations, solar radiations and the ionosphere, the Van Allen belt and cosmic rays, and telluric currents. C.L.W.

13 HEAT TRANSFER AND THERMODYNAMICS

Includes ablation; cooling; heating; and other thermal effects. *For aerothermodynamics see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; and 03 Aerodynamics of Wings, Rotors, and Control Surfaces. *For combustion see*: 26 Propellants and Combustion. *For related information see*: 11 Fluid Mechanics.

N64-15030 Deutsche Versuchsanstalt für Luft- und Raumfahrt, Stuttgart (W. Germany) Inst. für Spektroskopie und Molekularstrahltechnik
ON THE CALCULATION OF THE THERMODYNAMIC FUNCTIONS OF MIXTURES OF REAL GASES [ZUR BERECHNUNG DER THERMODYNAMISCHEN FUNKTIONEN VON GEMISCHEN REALER GASE]
H. Rittwagen Dec. 1963 55 p ref In GERMAN
(DVL-299) Available from Vereinigte Universitats-U. Fachbuchhandlungen, R.-Wagner-Str.1, Cologne, W. Germany

The equations for the calculation of the equilibrium concentration in dissociated real gases and the terms for the thermodynamic functions are derived, taking into account the second Virial coefficient. The numerical evaluation for the systems H_2O, OH, and O_2 and H_2 was made in the pressure and temperature range of 10 to 316 atm and 1400° to 5800° K. The deviations of these values from the calculated values for an ideal gas lie in the order of magnitude of corrections, wherein the effect of real-gas correction was examined in a consistent manner and taken into account. A comparison of the derived equations with those found in literature is made for the case of enthalpy. Trans. by I.v.L.

N64-15076 Naval Radiological Defense Lab., San Francisco, Calif.
CORRELATION FUNCTION CALCULATION OF THE LATTICE THERMAL CONDUCTIVITY BY CLASSICAL LIOUVILLE METHODS
W. C. Schieve and B. Leaf 18 Nov. 1963 18 p refs
(USNRDL-TR-694; AD-426394)

The methods of Prigogine and his collaborators, utilizing the classical Liouville operator, are used to evaluate the correlation function expression for lattice thermal conductivity. It is shown in the weak-coupling limit that the time dependent thermal flux appearing in the correlation function obeys the same master equation as the density function. By means of this master equation, it is shown for cubic anharmonic scattering that the correlation function expression and the usual Boltzmann transport equation calculation of the thermal conductivity in the classical limit give the same results. Author

N64-15097 Michigan U., Ann Arbor
INVESTIGATION OF LIQUID METAL BOILING HEAT TRANSFER
Richard E. Balzhiser, Robert E. Barry, Herman Merte, Jr., C. Phillip Colver, and Andrew Padilla, Jr. et al Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Nov. 1963 258 p refs
(Contract AF 33(616)-8277)
(RTD-TDR-63-4130; AD-429182)

A study of saturated pool boiling of potassium in the nucleate regime has supported the nucleate boiling data of other investigators. Values for the critical heat flux were determined experimentally over a pressure range of 0.1 psia to 22 psia. At atmospheric pressure the burnout flux was found to be approximately 600,000 Btu/(hr)(ft^2). Significant temperature fluctuations were observed in the potassium pool during the course of these investigations. Superheating was attributed to the difficulty in establishing nucleating sites at the heat-transfer surface in view of the strong wetting tendencies of the potassium and its high thermal diffusivity. The latter served to dissipate rapidly the energy required for nucleation in the boundary layer. Author

N64-15399 California U., Livermore. Lawrence Radiation Lab.
HIGH TEMPERATURE THERMAL CONDUCTIVITY
D. R. Stephens 21 Nov. 1963 19 p refs
(Contract W-7405-eng-48)
(UCRL-7605) OTS: $0.50

Values of the thermal conductivity of Nevada Test Site granite, basalt, tuff, and dolomite; Indiana limestone; and Gnome salt were measured to 1000° C using a steady-state method. Cylindrical rock samples were heated internally by a resistance-wire-wound porcelain tube, and temperatures were measured with thermocouples. The probable error in the data varied from

±5% to ±9%. These rather large values are believed due to the heterogeneous nature of the rock. Author

N64-15569 Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
ANALYSIS OF CONTACT HEAT EXCHANGE
Yu. P. Shlykov, E. A. Ganin, and N. B. Demkin 9 Jan. 1964 20 p refs Transl. into ENGLISH from Teploenerg. (Moscow), v. 7, no. 6, 1960 p 72–76
(RSIC-117; AD-429831)

The thermal resistance of contact between two rough surfaces (4th to 9th classes of finish) at various forces of compression may be determined with sufficient accuracy by using a calculation method. Components constituting thermal resistance of contact (R_r and R_s) in a wide diapason appear to be values of the same order. The change of thermal contact resistance in relation to the load is caused basically by the change of R_s (change R_r does not exceed 20%). At an increased load in excess of 200 kp/cm^2, the common thermal resistance remains practically constant. Author

N64-15639 Naval Ordnance Lab., White Oak, Md.
COMPARISON BETWEEN THE EXPERIMENTAL AND THEORETICAL HEAT TRANSFER TO A YAWED SPHERE-CONE MODEL AT SUPERSONIC SPEEDS
Lionel Pasiuk *In* Bur. of Naval Weapons Proc. of the 6th U.S. Navy Symp. on Aeroballistics [1963] 17 p refs (See N64-15626 07-11)

Experimental measurements of the laminar heat transfer to a sphere-cone model at angles of yaw up to 18° in supersonic flow have been made and compared with theoretical values. The streamline pattern over a yawed sphere-cone body can be calculated from the measured static-pressure distributions using the procedure developed by Harris. Application of a heat-transfer analysis suggested by Beckwith, together with the calculated streamlines, produced results which are in good agreement with the experimental data. Author

N64-15640 Naval Ordnance Lab., White Oak, Md.
RECENT HEAT-TRANSFER MEASUREMENTS AT HIGH-STAGNATION ENTHALPY AND HIGH REYNOLDS NUMBER
Barry J. Noonan and James L. Rand *In* Bur. of Naval Weapons Proc. of the 6th U.S. Navy Symp. on Aeroballistics [1963] 24 p refs (See N64-15626 07-11)
(Sponsored by Bur. of Naval Weapons)

Turbulent heat-transfer rates through a highly cooled boundary layer have been investigated experimentally by testing in the throat region of a reflected shock tunnel. Local heat-transfer measurements were made in a constant diameter pipe, simulating a flat plate, with extreme free-stream conditions. Unit Reynolds number, on the order of 3×10^7/ft, stagnation enthalpies approaching 8,000 Btu/lb, free-stream temperatures up to 8,000° K, and free-stream pressures of about 100 atm were generated by the shock tunnel for these experiments. Heat-transfer rates in the neighborhood of 50,000 Btu/ft^{2}sec were measured by means of a ring-type calorimeter heat-transfer gage. Author

N64-15641 North American Aviation, Inc., Columbus, Ohio
THERMAL EFFECTS OF SHOCK WAVE TURBULENT BOUNDARY LAYER INTERACTION AT MACH NUMBERS 3 AND 5
Victor Levin *In* Bur. of Naval Weapons Proc. of the 6th U.S. Navy Symp. on Aeroballistics [1963] 34 p refs (See N64-15626 07-11)
(Contract NOw-61-0679-c)

A wind-tunnel investigation was conducted at Mach numbers 3 and 5 of the heat transfer and pressure distributions on a flat plate in a region where a plane oblique shock wave impinges upon and interacts with a turbulent boundary layer. The strength of the shock was varied so that interaction regions both with and without separation were studied. In all cases except one, the length of the interaction region determined with the heat-transfer instrumentation was less than the interaction region specified by the variation in wall pressure. Plots of the ratio of the local Stanton number through the interaction region to the zero pressure-gradient Stanton number show qualitatively similar distributions for both Mach numbers and all shock strengths. Author

N64-15702 AeroChem Research Labs., Inc., Princeton, N.J.
TRANSPIRATION COOLING WITH CHEMICAL REACTIONS
Daniel E. Rosner Jan. 1964 33 p refs For presentation at the 53rd Ann. Meeting of AIChE on Heat Transfer with Chem. Reaction, Boston, 6–10 Dec. 1964
(AeroChem-TP-79)

Transpiration coolant requirements are examined for gas-solid systems in which the thermal effects of chemical reactions must be taken into account. For example, a coolant may undergo phase change and chemical decomposition in passage through the wall itself. This would alter the effective heat absorption capability and the mean molecular weight of the effluent gas. Further chemical reaction may occur when the coolant vapors (or decomposition products) mix with the hot gases in the boundary layer. In general, both processes will influence the amount of coolant required to maintain a prescribed surface temperature, and therefore significantly alter the relative merits of possible coolants. Simple computational techniques and numerical examples are given together with a discussion of several factors governing the rates of these chemical reactions. Author

N64-15740 Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
EXPERIMENTAL STUDY OF CONTACT HEAT EXCHANGE
Yu. P. Shiykov and E. A. Ganin 28 Jan. 1964 15 p refs Transl. into ENGLISH from Teploenerg. (Moscow), v. 8, no. 7, 1961 p 73–76
(RSIC-128; AD-430088)

The thermal resistance of actual contact is experimentally determined. For soft metals with a relatively high heat conductivity, the basic heat flow in the contact zone passes through the area of actual contact, whereas for hard metals with relatively low heat conductivity, the heat is mainly passed through gas. The change in the overall thermal resistance dependent on the load determines the change in conductivity of the actual contact. Author

N64-15789* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
TRANSIENT TECHNIQUES FOR DETERMINING THE THERMAL CONDUCTIVITY OF HOMOGENEOUS POLYMERIC MATERIALS AT ELEVATED TEMPERATURES
Robert G. Nagler 20 Jan. 1964 21 p refs
(NASA Contract NAS7-100)
(NASA CR-53071; JPL-TR-32-552) OTS: $2.60 ph, $0.83 mf

Linear thermal-conductivity relations at temperatures above room temperature were found from transient temperature-time data for polyethylene, polytetrafluoroethylene, and polymethylmethacrylate. The relations agree well with literature data for the same temperature ranges, but the computer time and cost of obtaining data points are significantly greater when compared to other measuring techniques of equivalent accuracy. Author

N64-15799 Argonne National Lab., Ill.
TWO PHASE (GAS-LIQUID) SYSTEM: HEAT TRANSFER AND HYDRAULICS An Annotated Bibliography
Robert R. Kepple and Thomas V. Tung (Ill. U.) Jul. 1963 435 p refs
(Contract W-31-109-eng-38)
(ANL-6734)

In this annotated bibliography information is presented in the following areas: boiling phenomena; bubbling; condenssation; evaporation; equations of state; interfacial characteristics; mass transfer across phase boundaries; measurement techniques; nuclear-reactor heat removal; and two-phase flow. C.L.W.

N64-15811 Electro-Optical Systems, Inc., Pasadena, Calif.
RE-ENTRY OBSERVABLES IN THE NEAR WAKE OF A SLENDER ABLATING TEFLON BODY Progress Report, Jan. 1964
E. Baum 3 Feb. 1964 31 p refs
(Contract DA-04-495-AMC-28-(Z2); ARPA Order 203-A1-63; Proj. Defender)
(EOS-RN-22; AD-429512)

Equilibrium compositions and temperatures are calculated for the laminar shear layer of a Teflon conical body, including profiles at the wake neck. Electron densities are found to be about two orders of magnitude below those in the shear layer of an equivalent cold wall nonablating body. This can be attributed principally to a lower peak temperature in the Teflon shear layer and to electron attachment to atomic fluorine. Author

N64-15847* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
HEAT-REJECTION AND WEIGHT CHARACTERISTICS OF FIN-TUBE SPACE RADIATORS WITH TAPERED FINS
Henry C. Haller, Seymour Lieblein, and Gordon C. Wesling (GE Co.) Washington, NASA, Feb. 1964 38 p refs
(NASA TN D-2168) OTS: $1.00

An analysis was made of the radiant blackbody heat-rejection and weight characteristics of a direct-condensing radiator with a linearly tapered fin between two tubes. Considered in the analysis are such factors as tube armor protection, mutual irradiation occurring between the fin and the adjoining tube surfaces, and fin base thickness and taper angle. Results of the thermal analysis for three fin tapers are presented in terms of a conductance parameter involving a comparison of the radiation capability of a fin with its heat conducting capability, the ratio of fin tip to base thickness, the ratio of tube outside radius to fin length, and the ratio of fin base thickness to fin length. For practical configurations, the effects of fin base thickness and taper angle on total heat transfer are negligible. Author

N64-15848 RAND Corp., Santa Monica, Calif.
THE INSENSITIVITY OF HEAT TRANSFER TO THE INCLUSION OF FIRST ORDER SLIP BOUNDARY CONDITIONS FOR SIMILAR LAMINAR HYPERSONIC BOUNDARY LAYERS
J. Aroesty Aug. 1963 11 p Submitted for Publication
(P-2780)

The problem of the hypersonic similar laminar boundary layer is modified to include first-order slip boundary conditions. It is observed that the inclusion of these new boundary conditions result in no change in the energy transfer to the wall from the no-slip values, implying that slip effects alone are not adequate to explain the appearance of the heat-transfer "plateaus" observed near the leading edge of a sharp flat plate in hypersonic flow. In addition, it is shown how the inclusion of slip boundary condition as the only higher order effect results in complete disagreement with observed pressure measurements for the cold-wall case. Author

N64-15882* National Bureau of Standards, Boulder, Colo. Cryogenic Engineering Lab.
FUNCTIONS FOR THE CALCULATION OF ENTROPY, ENTHALPY, AND INTERNAL ENERGY FOR REAL FLUIDS USING EQUATIONS OF STATE AND SPECIFIC HEATS
J. G. Hust and A. L. Gosman [1963] 18 p refs Prepared for the Cryog. Eng. Conf., Boulder, Colo., Aug. 19–21, 1963
(NASA Order R-45)
(NASA CR-55325; NBS-R-301) OTS: $1.60 ph, $0.80 mf

General integral equations for the determination of entropy, enthalpy, and internal energy are derived. The integration path is taken to be on the real-gas surface, thus yielding one set of equations. Then the integration path is defined such that ideal-gas specific heats and reference properties are introduced. The latter set of integral equations are applied to a particular equation of state resulting in algebraic expressions for the entropy, enthalpy, and internal energy. Author

N64-15893* Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
EXPERIMENTAL INVESTIGATION OF HEAT TRANSFER TO NUCLEAR ROCKET NOZZLES USING SHOCK TUBE TECHNIQUES, PHASE I
E. A. Czeck 15 Oct. 1963 202 p refs
(NASA Contract NASw-344; Proj. No. HM-1650-Y)
(NASA CR-55712; HM-1650-Y-1) OTS: $14.00 ph, $6.26 mf

An experimental investigation was performed to determine the gas-side convective heat transfer to the nozzles of nuclear rockets. Shock-tube techniques were employed to shock heat and to compress the test gas. Tests were conducted on three nozzles of different geometries. Supply pressures ranged from 27 to 1,864 psia, and the stagnation temperature varied from 1,288° to 4,078° R. The test gases were air, nitrogen and hydrogen. Local nozzle pressures and heat-transfer rates were measured at several locations in the test nozzles. This report presents the details of the test program, an outline of the test procedure, and the results in plotted and tabular form. Author

N64-15894* Cornell Aeronautical Lab., Inc. Buffalo, N.Y.
EXPERIMENTAL INVESTIGATION OF HEAT TRANSFER TO NUCLEAR ROCKET NOZZLES USING SHOCK TUBE TECHNIQUES, PHASE II
E. A. Czeck 11 Oct. 1963 109 p refs
(NASA Contract NASw-344; Proj. No. HM-1650-Y)
(NASA CR-55713; HM-1650-Y-2) OTS: $9.10 ph, $3.47 mf)

Tests were conducted on three nozzle geometries. Supply pressures ranged from 62 to 597 psia, and the stagnation temperatures varied from 2,010° to 4,920° R. Hydrogen was utilized for the test gas. Local nozzle pressures and heat-transfer rate rate distribution were measured. Author

N64-15909* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
TWO-DIMENSIONAL GRAY-GAS RADIANT HEAT TRANSFER IN A COAXIAL-FLOW GASEOUS REACTOR
Robert G. Ragsdale and Thomas H. Einstein Washington, NASA, Feb. 1964 31 p refs
(NASA TN D-2124) OTS: $0.75

A two-dimensional radiation heat-transfer analysis was applied to a cylindrical system of coaxially flowing gray gases (constant absorption coefficient) in which the inner stream contains a radially uniform distribution of volumetric heat sources. The absorption coefficient, reactor length, and flow parameters were varied over a range of conditions. For a 10-ft.-diam. reactor and an absorption coefficient of 2 per ft, the heat load on the channel wall was less than 1% of the

generated power, and the maximum wall heat flux was 12 Btu/sec/in.^{2} The temperature of the heat-generating core is relatively constant over the length of the reactor. Wall heat flux is not significantly affected by the core velocity. The heat radiated to the reactor wall comes primarily from the hydrogen immediately adjacent to it. Therefore, the wall heat flux is strongly affected by the propellant (outer stream) flow rate and absorption coefficient and by channel dimensions, but it is not directly affected by changing conditions in the central core itself. Author

N64-15912* California Inst. of Tech., Pasadena
APPARATUS TO MEASURE THE THERMAL CONDUCTIVITY OF POWDERS IN VACUUM FROM 120 TO 350° K
Kenneth Watson and Curtis A. Bauman Repr. from Rev. Sci. Instr., v. 34, no. 11, Nov. 1963 p 1235–1238 refs
(NASA Grant NsG-56-60)

An apparatus enclosed in a sand-cast aluminum vacuum chamber capable of retaining pressures of 10^{-5} to 10^{-6} torr was used to measure the thermal conductivity of powder samples in vacuum. The base of the sample was heated by the temperature bath on which it rested, and the top surface of the sample radiated into a cavity that was maintained at liquid nitrogen temperature (77° K). The thermal conductivity of the powders was calculated from the emitted flux, the sample thickness, and the bath temperature. Author

N64-15929* Minnesota U., Minneapolis Heat Transfer Lab.
ANGLE FACTORS FOR RADIANT INTERCHANGE BETWEEN PARALLEL-ORIENTED TUBES
E. M. Sparrow and V. K. Jonsson Repr. from Trans. Am. Soc. Mech. Engrs., Nov. 1963 p 382–384
(NASA Grant NsG-137-61)

The purpose of this brief paper is to provide information, otherwise unavailable in the literature, on angle factors for the diffuse interchange of radiant energy between cylindrical tubes that are oriented parallel to one another. This information has application in the analysis of fin-tube radiators, boiler tubes, etc. Author

N64-15960 Aerospace Corp., El Segundo, Calif. Systems Research and Planning Div.
ABLATING BODY HEAT TRANSFER
J. A. Quinville and J. Solomon 15 Jan. 1964 89 p refs
(Contract AF 04(695)-269)
(SSD-TDR-63-159; TDR-269(4560-10)-1; AD-429198)

A computational technique is described that determines the transient aerodynamic heating and ablation of a vehicle throughout an arbitrary flight trajectory. Both laminar and turbulent boundary layers are treated for flows over blunt or sharp-nosed two-dimensional or axisymmetric bodies. The effects of real-gas dissociation, as well as chemically reacting ablation, are considered. The chemical reactions include both diffusion-limited and rate-limited combustion of carbon. The transient heat-conduction model treats the one-dimensional flow of heat into a material that may be of the char-forming type with internal depolymerization. The computational technique has been coded in FORTRAN for an IBM 7090. A series of examples are shown and compared with experimental data demonstrating the accuracy that may be expected. The numerical solutions for an ablating char-forming material using the complete boundary-layer and heat-conduction programs are considered satisfactory. The combined programs can be improved from the present conditions in several areas leading to shorter computational times. Author

N64-16024 Columbia U., New York, N.Y. Engineering Research Labs.
A PHOTOGRAPHIC STUDY OF BOILING FLOW
John H. Vohr Washington, AEC Div. of Tech. Inform. 25 Oct. 1963 191 p refs
(Contract AT(30-3)-187)
(NYO-9650) OTS: $2.75

A high-speed motion picture study was conducted of boiling flow in a vertical, rectangular channel at atmospheric pressure. Three different visual flow regimes were defined and described. These were bubble flow, coalescing flow, and slug-annular flow. An original technique for measuring two-phase flow velocities was developed, and velocity measurements were made in all the flow regimes described. A quantity denoted as flow pattern scale was defined and measured. This quantity is, essentially, a measure of the characteristic size of the vapor and liquid volumes composing a flow pattern. A model for slug-annular flow was advanced, based on velocity measurements and study of the motion pictures of the flow. Author

N64-16106* Georgia Inst. of Tech., Atlanta Engineering Experiment Station
HEAT TRANFER TO A GAS CONTAINING A CLOUD OF PARTICLES Semi-annual Status Report No. 3, 1 Jun–30 Nov. 1963
Andrew Mc Allister, Henderson C. Ward, Alberto F. Hidalgo, and Clyde Orr, Jr. 10 Jan. 1964 59 p refs
(NASA Grant NsG-273-62)
(NASA CR-55518) OTS: $5.60 ph, $1.97 mf

Clouds of particles suspended in a gas have been found to increase the ability of the system to absorb radiant energy. It is the objective of this project to provide basic information derived from both theoretical analyses and experimental observations of these systems. Presented are a summary and discussion of the experimental investigation of heat transfer to several zinc-air and ferrous-sulfide air systems. R.T.K.

14 HUMAN BEHAVIOR

Includes crew training and evaluation; piloting; and psychological factors. *For simulators see*: 10 Facilities, Research and Support. *For related information see*: 16 Life Sciences.

N64-15105 Naval School of Aviation Medicine, Pensacola, Fla.
HUMAN QUALITY CONTROL
James R. Berkshire In ONR Solution to Navy Probl. through Advanced Technol. [1963] p 31–40 (See N64-15101 07-01) OTS: $5.00

The method for selecting men for aviation training is discussed. Minimum training standards that will result in the early elimination of potential training and job failures must be imposed at various levels of the training process. In order to transform all of a student's valid past performance scores into a single statement of the probability of his success or failure, a computer was used. R.T.K.

N64-15106 Naval Air Development Center, Johnsville, Pa. Aviation Medical Acceleration Lab.
PILOT PERFORMANCE DURING CENTRIFUGE SIMULATIONS OF ACCELERATION ENVIRONMENTS
Randall M. Chambers and W. S. Wray In ONR Solution to Navy Probl. through Advanced Technol. [1963] p 41–88 refs (See N64-15101 07-01) OTS: $5.00

A report is presented of the results of centrifuge simulation studies of manned space flights and of proposed spacecraft. The major effects of long-term accelerations on human performance and physiology are presented. Physiological tolerance to $+G_x$, $+G_z$, $-G_x$, and $-G_z$ acceleration vectors are discussed, and it is demonstrated that, in addition to physiological tolerance limits, there are also performance tolerance limits that define the realizable functioning of any particular overt-behavior system during acceleration. Major concepts in protection are discussed. Some of the pasic principles of centrifuge simulation of space vehicles are outlined, and the use of the Aviation Medical Acceleration Laboratory centrifuge in astronaut training is reviewed. The effects of various acceleration profiles on visual performance, response time, complex psychomotor-skill performance and higher mental function, and motivation and emotional behavior are outlined. R.T.K.

N64-15347* Naval School of Aviation Medicine, Pensacola, Fla.

A COMPARISON OF THE SYMPTOMATOLOGY EXPERIENCED BY HEALTHY PERSONS AND SUBJECTS WITH LOSS OF LABYRINTHINE FUNCTION WHEN EXPOSED TO UNUSUAL PATTERNS OF CENTRIPETAL FORCE IN A COUNTER-ROTATING ROOM

Ashton Graybiel and Walter H. Johnson 22 Jun. 1962 18 p refs Joint Report with NASA
(NASA Order R-47)
(NASA CR-55621; BuMed-70) OTS: $1.60 ph, $0.80 mf

With head fixed and eyes closed, all of the subjects perceived the changing direction of resultant force with respect to themselves as an illusion of rotation and the direction of resultant force as a tilt from the vertical with respect to the earth or floor of the room. With room lighted it appeared to be tilted, the oculogravic illusion, and in this regard there may have been differences between the normal and labyrinthine defective subjects. Some of the normal but none of the L-D subjects experienced symptoms of motion sickness. This group difference must have been attributable to the auricular sensory organs, and these differences are discussed under two headings, precipitating and predisposing factors. Predisposing factors accounted for the great interindividual variance in susceptibility. These are discussed briefly in terms of basic and acquired factors. Author

N64-15348* Naval School of Aviation Medicine, Pensacola, Fla.

THE VALIDITY OF TESTS OF CANAL SICKNESS IN PREDICTING SUSCEPTIBILITY TO AIRSICKNESS AND SEASICKNESS

Robert S. Kennedy and Ashton Graybiel 27 Jun. 1962 11 p refs Joint Report with NASA
(NASA Order R-47)
(NASA CR-55620; BuMed-71) OTS: $1.60ph, $0.80 mf

It was found that a positive relationship existed between performance in the tests of canal sickness and airsickness. This relationship also existed during exposure to heavy seas and to a lesser extent to moderate seas. In general, it may be concluded that the individual's performance in the standard procedure used to produce canal sickness aboard the slow-rotation room and his reaction to caloric stimulation are predictive of his susceptibility to air and seasickness. Author

N64-15349* Naval School of Aviation Medicine, Pensacola, Fla.

HUMAN PERFORMANCE DURING TWO WEEKS IN A ROOM ROTATING AT THREE RPM

Fred E. Guedry, Jr., Robert S. Kennedy, Charles S. Harris, and Ashton Graybiel 28 Aug. 1962 29 p refs Joint Report with NASA
(NASA Order R-47)
(NASA CR-55622; BuMed-74) OTS: $2.60 ph, $1.07 mf

Four men were tested before, during, and after being rotated at 3 rpm for 2 weeks in a slow-rotation room. The men also lived in the room preceding the commencement of the rotation. Tests of intellectual and physiological function were included. The principal finding was that no serious psychological or physiological deficit was detected during 2 weeks of rotation or during the subsequent readaptation to normal environment. The only test showing pronounced deterioration of performance at the beginning of rotation and upon returning to normal environment was the Graybiel–Fregly posture test. This means that any task requiring ordinarily difficult locomotion would be disturbed at these critical intervals. Ordinary walking with adequate visual reference was not so obviously affected. Results are discussed in relation to problems of rotating space stations, the vestibular system, and experiments involving optically distorted visual information. Author

N64-15353* Naval School of Aviation Medicine, Pensacola, Fla.

A BIOINSTRUMENTATION CONTROL CENTER FOR THE HUMAN DISORIENTATION DEVICE Final Report

W. Carroll Hixson and Jorma I. Niven 11 Mar. 1963 57 p refs Joint Report with NASA
(NASA Order R-1)
(NASA CR-55615; BuMed-79) OTS: $5.60 ph, $0.80 mf

The Human Disorientation Device, a multiaxis rotator comprising an experimental capsule, electromechanical drive system, and basic controls, was developed to generate angular acceleration profiles of known magnitude and duration with precise and repeatable quantification of the rotatory stimuli. It was then desired to extend the control system and provide instrumentation for observing, monitoring, and controlling the performance of subjects in this two-axis, angular-acceleration environment. The implementation of an integrated instrumentation system for the acquisition and analysis of biomedical data and for the correlation of precise simulator variables with the bioelectronic requirements of the experimental programs is described. Author

N64-15354* Naval School of Aviation Medicine, Pensacola, Fla.

ROLE OF THE OTOLITH ORGANS IN THE PERCEPTION OF HORIZONTALITY

Earl F. Miller II and Ashton Graybiel 19 Mar. 1963 22 p refs Joint Report with NASA
(NASA Order R-37)
(NASA CR-55616; BuMed-80) OTS: $2.60 ph, $0.86 mf

The influence of the sensory organs of the inner ear on man's ability to align a visual target with the horizontal was measured utilizing (1) discrete and (2) continuous setting methods. Both test methods yielded similar results under all test conditions. When visual background cues were present, settings of the luminous line target to the horizontal were quite accurate in the nine normal and ten labyrinthine defective (L-D) subjects placed in three head (body) positions: upright, recumbent, and inverted. Removal of empirical visual cues revealed, particularly in the recumbent position, that qualitatively all subjects perceived the typical lag in onset, relatively slow rotation to the maximum illusion, and rotary autokinesis. Quantitatively, however, there were significant intergroup differences. In spite of the fact that there was some overlap in the group distributions of settings obtained in the

upright and recumbent positions, indicating other factors were involved, the intergroup perceptual differences are best explained as an effect of loss of otolith function in the L-D subjects. It was concluded that the otolith organs in man act to increase his accuracy in egocentric visual localization, at least in the upright and recumbent positions. Author

N64-15355* Naval School of Aviation Medicine, Pensacola, Fla.
PERCEPTION OF THE POSTURAL VERTICAL FOLLOWING PROLONGED BODILY TILT IN NORMALS AND SUBJECTS WITH VESTIBULAR DEFECTS
Brant Clark and Ashton Graybiel 10 Apr. 1963 9 p refs Joint Report with NASA
(NASA Order R-37)
(NASA CR-55614); BuMed-81) OTS: $1.10 ph, $0.80 mf

This study was carried out to compare the effect of prolonged bodily tilt of varying amounts on the perception of the postural vertical in normal subjects and in subjects with defective vestibular mechanisms in order to obtain additional data concerning the function of the otoliths in the perception of the postural vertical. Two conditions of delay before the subjects set themselves to vertical and four degrees of tilt comprised the experimental design. A 2 × 2 × 4 analysis of variance showed significantly greater average errors for the 10 men with defective vestibular function than for the nine normal men, for prolonged delay in recovery to vertical and for the larger tilts. Author

N64-15518 Cincinnati U., Ohio
AN EVALUATION OF BRANCHING AND MOTIVATIONAL PHRASES IN A SCRAMBLED BOOK
R. J. Senter, A. Nieberg, J. S. Abma, and R. L. Morgan Wright-Patterson AFB, Ohio, Behavioral Sci. Lab., Nov. 1963 19 p refs
(Contract AF 33(657)-10234)
(AMRL-TDR-63-122; AD-429459) OTS: $0.50

This study evaluated three experimental versions of the scrambled text "The Arithmetic of Computers" by Norman A. Crowder. The three versions were: (1) unmodified, (2) modified by deletion of motivational phrases, and (3) straight line having neither motivational phrases nor branching. Results showed no significant differences in amount learned or in study time. Author

N64-15747 Lockheed-Georgia Co., Marietta Human Factors Research Dept.
HUMAN GROUP PERFORMANCE DURING CONFINEMENT Final Report
Earl A. Alluisi, Thomas J. Hall, Glenn R. Hawkes, and W. Dean Chiles (AFSC) Nov. 1962 137 p refs
(Contract AF 33(616)-7607-M4)
(ER-6024; AD-429858) OTS: $10.50

The purpose of this study was to investigate the feasibility of using a work–rest schedule of 4-hours-on-duty and 2-hours-off relative to using a 4-on and 4-off schedule in the operation of advanced aerospace systems. Six Air Force Academy Cadets were confined for 15 days in a simulated advanced-system crew compartment while following the 4–2 schedule, and two 5-man crews of USAF pilots were confined for 30 days while following the 4–4 schedule. With the smaller crew and the 4–2 schedule, 4 work stations were operated continuously for the 15 days, whereas 5 were operated by the two 5-man crews, who alternated 4-hour work shifts continuously for 30 days. While on duty, the operators were tested with a battery of 6 performance tasks, 2 of which were crew-performance tasks requiring interactions among crewmembers in the form of exchanges of information, cooperation, and temporal coordination. In addition, the data of the present studies were compared with those of a previous 15-day test of two B-52 combat-ready crews, who worked the 4–2 schedule, while being tested with a battery of 5 individual performance tasks. Author

N64-15752 Air Force Systems Command, Bedford, Mass.
HUMAN ENGINEERING EVALUATION OF A-MOBILE AIR TRAFFIC CONTROL AND COMMUNICATION SYSTEM, AN/TSQ-47
John Coules and Stephen E. Stuntz Dec. 1963 27 p refs
(ESD-TDR-63-656; AD-429879)

The potential hazards to personnel of gas-turbine power generators were assessed for noise output and portability. Results showed moderate to severe hearing damage risk for personnel working in the vicinity of the generators. The generator unit appears to be an unsafe load for four airmen to lift and carry with the hand grips as configured. Speech intelligibility tests were conducted on a portion of the RACEP communication system. Results indicated potentially serious limitations of this equipment for field use. Author

N64-15753 Naval Air Development Center, Johnsville, Pa. Aviation Medical Acceleration Lab.
PSYCHOPHYSIOLOGICAL ASPECTS OF REDUCED GRAVITY FIELDS, REPORT NO. 6
Cleto Di Giovanni and Randall M. Chambers 30 Dec. 1963 25 p refs
(Partially supported by NIH)
(NADC-MA-6305; AD-430095)

Considerable data have been collected concerning acceleration physiology from centrifuge, rocket sled, and drop tower studies but weightlessness has remained a poorly understood environment primarily because there is no way to duplicate it on earth. This report considers the various methods used to study or approximate the subgravity state, and the results and extrapolations that have been drawn from them. The cardiovascular and musculoskeletal aspects of recent bed-rest and water-immersion studies are examined, and results are compared with the data from actual space flights. Real weightlessness apparently has been an innocuous environment thus far, and the only factor of concern has been a tendency toward postural hypotension detected immediately following recovery after missions of 9 and 34 hours. As longer missions are achieved, other problems, such as muscle atrophy and excessive calcium mobilization, may appear. Author

N64-15755 Naval Air Development Center, Johnsville, Pa. Aviation Medical Acceleration Lab.
PSYCHOLOGICAL ASPECTS OF WATER IMMERSION STUDIES Report No. 7
John C. Ferguson, and Randall M. Chambers 30 Dec. 1963 28 p refs
(NADC-MA-6328; AD-429523)

The purpose of this paper was to review the recent water immersion literature, placing special emphasis on the psychological aspects of these studies. The adequacy of water immersion as a technique for simulating weightlessness was discussed, and water immersion facilities and procedures were described. The areas of perceptual and motor performance, boredom and fatigue, sleep, orientation, and personality and emotional aspects of water immersion were selected as being of special psychological interest. Author

N64-15841* National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio
PILOT REACTION TO HIGH SPEED ROTATION

James W. Useller and Joseph S. Algranti Repr. from Aerospace Med., v. 34, no. 6, Jun. 1963 p 501–504 refs Condensed version of paper presented at 11th Internatl. Astronautical Cong., Stockholm, 1960 (Previously Published as reprint; see N63-20213 20-14)
(NASA RP-133)

During rotation at rates up to 70 rpm about a resultant axis, the pilots were able to perform a complex task requiring judgment and manual dexterity with a performance error that ranged from 6.5 to 18 percent, depending on the individual evaluated. Repeated operation of a similar type rotational test showed that the pilot was able to reduce his error appreciably. He also was able to improve his technique by introducing several corrections simultaneously. Intermittent rotation at rates of 50 rpm or greater for periods longer than 1 hr could induce motion sickness symptoms. Vestibular nystagmus was encountered by all the subjects tested when the acceleration was endured for at least 10 sec. However, if the subject concentrated on a centralized area of his instrument panel, the effects were reduced. Author

N64-15855 Boeing Co., Wichita, Kan.
VISUAL PERFORMANCE DURING WHOLE-BODY VIBRATION Technical Report No. 4
Robert J. Teare, and D. L. Parks Nov. 1963 36 p refs
(Contract Nonr 2994(00))
(D3-3512-4; AD-427254)

Eight male volunteers were tested in the vibration facility to determine the effect of whole-body vibration on the ability to read counter information. Stimuli consisted of five 5-digit counters varying in height from 0.05 to 0.2 in. (6 to 24 minutes visual angle at an average viewing distance of 28 in.) Vibration frequencies ranged from 1 to 27 cps at each of four subjective reaction levels. Both vibration frequency and severity (reaction level) significantly affected two of the five counters. The size of the counter was a factor only if it subtended less than 12 minutes of arc. The most severe area of visual deterioration was from 12 through 23 cps. This was linked to the critical flicker frequency of the eye. Author

N64-16053 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
COSMOS — EARTH
V. V. Parin 21 Jan. 1963 8 p Transl. into ENGLISH from Ogonek (Moscow), no. 17, 1961 p 26–27
(FTD-TT-62-1609/1; AD-295778)

The effect of the environment of outer space on man and plants is discussed. R.T.K.

N64-16074 Institute for Research, State College, Pa.
UTILITY, INDUCED UTILITIES AND SMALL WORLDS
Masanao Toda and Emir H. Shuford, Jr. Bedford, Mass., Decision Sci. Lab., Oct. 1963 46 p refs
(Contract AF 19(628)-2968; NSF Grant GS-114)
(Rept. 9; ESD-TDR-63-622; AD-424752)

Decision theory in its present state of development fails to provide sufficient criteria for the unique formulation of a decision problem. The resulting ambiguity may lead to quite disparate interpretations of the same decision task by different individuals. The inconsistencies found in the measurement of the "utilities" of objects, which in reality serve as means to an end, and in the Chipman–Ellsberg–Fellner paradox may arise from differences between experimenter and subject in their formulation of the decision task. This ambiguity can be reduced either by analyzing the decision task in the largest context feasible or by introducing structural constraints on the formulation of the decision problem. Author

N64-16088 Massachusetts U., Amherst
INFORMATION PROCESSING UNDER TASK STRESS
Warren H. Teichner Bedford, Mass., Decision Sci. Lab., Nov. 1963 61 p refs
(Contract AF 19(628)-290)
(ESD-TDR-63-657; AD-430412)

This is the final report of studies of human information processing related to variables present in high-speed systems operations. Earlier reported data pertinent to the effects of informational input rates and related factors are reviewed. The report then presents experiments concerned with two other aspects of the problem: (1) the interaction of short- and long-term memories in human data handling; and (2) the effects of presented information rates on "subjective information," i.e., the amount of information in the operator's estimate of what is presented by the display. Author

N64-16089 Army Medical Research Lab., Fort Knox, Ky.
PERFORMANCE DECREMENT IN VEHICLE DRIVING
Marvin J. Herbert and William E. Jaynes 12 Nov. 1963 17 p refs
(Rept.-597; AD-430226)

Long hours of driving result in a decrement of skills employed in vehicle manipulation. This loss can be measured by appropriately designed driving tests. The decrement function is not linear. Subjects driving from 0 to 7 hours showed progressive deterioration in test performance, whereas no decrement was observed after 7 hours. Author

N64-16111* Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
STUDIES OF MANUAL CONTROL SYSTEMS Progress Report No. 2, 19 Jul. 1963–18 Oct. 1963
18 Oct. 1963 41 p refs
(NASA Contract NASw-668)
(NASA CR-55514) OTS: $4.60 ph, $1.43 mf

An adequate description or model for the human controller is far from being an actuality. In the single-axis, single-display situation, the models now available are probably satisfactory for a large number of problems, but these models relate to the interaction between input, controlled-element dynamics, and human-controller dynamics. They do not include interactions involving display and manipulator dynamics. Models approximating the multiaxis, multidisplay, and adaptive behavior of the human controller are primitive. A promising approach to the development of such models is based on concepts of sampled-data control systems and information theory. I.v.L.

15 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gauges; sensors and transducers; and telescopes and cameras. *For related information see*: 06 Auxiliary Systems; 08 Communications; 09 Electronics; and 22 Navigation and Guidance.

N64-15029 Deutsche Versuchsanstalt für Luft- Und Raumfahrt, Porz (W. Germany) Inst. für Raumfahrtforschung
CONTRIBUTION TO THE MATHEMATICAL FUNDAMENTALS OF THE MASS FILTER [BEITRAG ZU DEN MATHEMATISCHEN GRUNDLAGEN DES MASSENFILTERS]

Manfred Jones Dec. 1963 44 p refs In GERMAN
(DVL-298) Available from Vereinigte Universitäts- U. Fachbuchhandlungen, R.-Wagner-Str. 1, Cologne, W. Germany

A mathematical model of the processes in the separation system of an analyzer, a mass filter for mass spectroscopy, is presented. After the general solution of the potential equation is obtained, a term is given for the potential in the axis of the analyzer on the basis of physical considerations. The motion equations of the components of the analyzer lead to a Mathieu differential equation, the stable and unstable solutions of which are discussed. Trans. by I.v.L.

N64-15055 Electro-Mechanics Co., Austin, Tex.
EQUIPMENT FOR MEASUREMENT OF MAGNETIC FIELD VARIATIONS FOR DASA PROJECT 6.5A Final Engineering Report No. 3, 28 Feb.-30 Nov. 1962
F. J. Morris, C. R. Coale, W. E. A. Ruska, and E. J. Chernosky
(AFCRL) 30 Apr. 1963 25 p refs
(Contract AF 19(604)-5520)
(AFCRL-63-939(3); AD-428271)

Magnetometers were constructed for instrumenting two field magnetic and telluric observatories. The purpose of these observatories, established and operated in the Pacific area, was to measure and record geomagnetic phenomena corresponding to the high-altitude nuclear test series in 1962. The stations were manned, and data were successfully taken for all events specified to be of interest by the contract monitor. Author

N64-15159 Bureau of Mines, Albany, Oreg. Albany Metallurgy Research Center
A PENETROMETER FOR MEASURING THE ABSOLUTE VISCOSITY OF GLASS
John E. Kelley, Thomas D. Roberts, and Henry M. Harris 1964 15 p refs
(BM-RI-6358)

A penetrometer apparatus for measuring viscosity of glass at temperatures up to 1,450° C was developed for use in establishing the viscosity coefficients required for high-temperature forming of ceramic materials. The device, which operates on a single penetrometer principle, was used to determine the absolute viscosity coefficient of substances in centimeter-gram-second units of poises instead of relative penetration-rate units as with other penetrometers. Penetration of the viscous sample was sensed with a linear, variable differential transformer. The output of this transformer was recorded versus time, and the penetration rate was used in calculating the viscosity coefficient. The general equation relating penetration rate and viscosity coefficient was found to be

$$\eta = \frac{F(1nL/a - 0.72)}{2\pi UL}$$

where η is the viscosity coefficient in poises, F is the penetrator load in dynes, L is the penetration depth in centimeters, a is the penetrator radius in centimeters, and U is the penetration rate in centimeters per second. Author

N64-15302* Rochester U., N.Y.
PHOTOELECTRIC PROPERTIES OF LEAD SULFIDE IN THE NEAR AND VACUUM ULTRAVIOLET
Richard A. Knapp (Ph. D. Thesis) Repr. from Phys. Rev., v. 132, no. 5, 1 Dec. 1963 p 1891-1897 refs
(NASA Contract NASw-107)

Measurements of photoelectric yield and electron energy distribution have been made on natural crystals of lead sulfide, Peruvian galena, in spherical photocells at pressures of 10^{-8} mm Hg. Under these conditions, maximum yields are found to be of the order of 1% in contrast to the much higher yields previously reported for this material. Yield data for cesium-coated samples are also presented, as are values of the optical absorption coefficient in the range 4 to 12 ev. Observed effects are interpreted as indicating the existence of an additional valence band whose maximum is located approximately 4 ev below the top of the higher bands. Such an assignment is found to be in qualitative agreement with the computed band structure. Author

N64-15314 Radio Corp. of America, Patrick AFB, Fla.
BALLISTIC CAMERA ACCURACY REVIEW
G. H. Rosenfield et al *In* AF Missile Test Center New Data Reduction Methods to Improve Range Data [1963] p 17-54 (See N64-15312 07-01)

This report is a compilation of the separate final reports from each of the major areas of activity concerned with the determination and the correction of errors of the AMR Ballistic Camera systems required for calibration of the MISTRAM System. The history of the Ballistic Camera Accuracy Review project (BACAR) is described. The reasons for, the objectives, and the methods of the project are discussed in detail. An indication of the amount of effort expended to evaluate and calibrate the Ballistic Camera System is given. Discussion of the major accomplishments to date, as well as the limiting problem areas for the future is also presented. Author

N64-15323 Radio Corp. of America, Moorestown, N. J. Missile and Surface Radar Div.
INSTRUMENTATION ERRORS DUE TO ATMOSPHERIC REFRACTION
David K. Barton *In* AF Missile Test Center New Data Reduction Methods to Improve Range Data [1963] p 285-322 refs Summary of the Natl. Acad. of Sci. Ad Hoc Panel Rept. on Electromagnetic Propagation (See N64-15312 07-01)

A committee report on the current extent of knowledge concerning atmospheric refraction and its effect on tracking accuracy is presented. Subjects discussed include tropospheric errors, ionospheric errors, tropospheric correction procedures, and effects on typical instrumentation systems. Conclusions and recommendations are included. J.E.T.

N64-15325 Air Force Cambridge Research Labs., Bedford, Mass. Geodesy and Gravity Branch
CALIBRATION SATELLITE
Armando Mancini and D. C. Brown (Brown Associates) *In* AF Missile Test Center New Data Reduction Methods to Improve Range Data [1963] p 339-364 (See N64-15312 07-01)

The role of satellites in the calibration of range instrumentation is discussed and includes the simultaneous calibration of several electronic systems and the checking of system performance over the ranges and velocities for which the equipment was developed and will operate. J.E.T.

N64-15386* Harvard Coll. Observatory, Cambridge, Mass.
FERROELECTRIC BOLOMETER FOR SPACE RESEARCH Scientific Report No. 3
Hector C. Ingrao, Frederick J. Kahn, and Donald H. Menzel 1 Nov. 1963 57 p refs
(NASA Grant NsG-64-60)
(NASA CR-55542) OTS: $5.60 ph, $1.91 mf

The ferroelectric bolometer is compared with other thermal detectors for use in space instrumentation. Ceramic ferroelectric bolometers were manufactured with Curie points between

−10° C and +10° C and dimensions as low as 0.5 mm × 0.5 mm × 50μ. The performance of a radiation pyrometer with a ferroelectric bolometer 1.0 mm × 1.0 mm × 0.2 mm was measured. With an incident infrared signal of 5.8×10^{-9} watts peak-to-peak chopped at 2.5 cps, and a bandpass $\Delta f = 0.25$ cps at room temperature, the noise level of the system is 4.2×10^{-10} watts rms. Theoretical analyses of the responsivity and minimum detectable power are presented. Author

N64-15476 General Electric Co., Ltd., Stanmore (Gt. Brit.)
AN OPTICAL STATIC-SPLIT RECEIVER FOR MOON-TRACKERS IN SATELLITES AND SOUNDING ROCKETS
P. Irvin *In* AGARD, Paris Light and Heat Sensing 1963 p 371–394 (See N64-15452 07-23)

Certain aspects of an optical static-split receiver suitable for use as the input element of a moon-tracking servomechanism are studied. The paper discusses the misalignment characteristics to be expected when photodiodes are used in conjunction with a diffusing type of image-splitting block having a circular central mask, or when solar cells are placed in the image plane of a telescope in such a way as to split the moon's image. The effects upon the output of the receiver of changes in the detector geometry are considered theoretically, and the results of experiments are presented. Author

N64-15477* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
THE APPLICATION OF OPTICAL SENSORS FOR LUNAR AND PLANETARY SPACE VEHICLES
John R. Scull *In* AGARD, Paris Light and Heat Sensing 1963 p 395–410 refs (See N64-15452 07-23)
(NASA Contract NAS7-100)

The overall intensity range covered by the optical sensors in a spacecraft is greater than twelve orders of magnitude. To meet these requirements, some of the types of sensors employed include solid-state photoconductors, photomultipliers, vidicons, and thermistor bolometers. Some examples of optical sensors used for lunar and planetary missions are presented. The results of tradeoff studies on sensitivity, accuracy, and field of view are discussed. The ground testing and simulation techniques that are unique for interplanetary optical sensors are described. Flight test results from the Ranger spacecraft are reported. Author

N64-15496 Harvard U., Cambridge, Mass. Gordon McKay Lab.
A WIRELESS PROBE FOR MEASURING AN ELECTROMAGNETIC FIELD Scientific Report No. 5
Keigo Iizuka 15 Apr. 1963 25 p refs
(Contract AF 19(604)-7262; NSF Grant 20225)
(AFCRL-63-889; AD-429050)

A miniature FM transceiver consisting of a 7-Mc Esaki diode oscillator has been built for the purpose of telemetering the field intensity of 114-Mc electromagnetic waves. This wireless probe is designed to be used under water as well as in free space. Descriptions include the design of the transceiver circuit, the layout of the components, and the measured results using the wireless probe. Author

N64-15571 Lexington Labs., Inc., Cambridge, Mass.
INVESTIGATION OF HIGH TEMPERATURE THERMAL EXPANSION DEVICES AND DESIGN OF A UNIT FOR USE WITH THERMAL IMAGE HEATING Final Report
Robert C. Folweiler and Philip S. Schaffer 15 Dec. 1963 28 p refs
(Contract AF 19(628)-1616)
(AFCRL-63-591; AD-429180)

The double-clamshell arc imaging system has been successfully applied in a practical arrangement for physical property measurements. Thermal expansion measurements of alumina and zircon have been made to 1,950° K (1,670° C). An inflection in slope of the thermal expansion of zircon was observed at 1,570° K, indicating a possible phase transition previously unreported. Simple modifications (coating of mirrors) will provide higher temperatures (calculated at 2,260° K). Electrical property measurements can be made in the field-free environment. Author

N64-15575 Air Force Systems Command, Wright-Patterson AFB, Ohio
MEASURING INSTRUMENTS FOR THERMAL PROCESSES
K. A. Mironov and L. I. Shipetin 7 Oct. 1963 1038 p refs Transl. into ENGLISH from the book "Teplotekhnicheskiye Izmeritel'nyye Pribory" Moscow, Mashgiz, 1958 p 1–896 (FTD-TT-63-16; AD-429105)

This book gives the fundamental characteristics, external connections, and overall dimensions of instruments for measuring temperature, pressure, quantity and rate of flow of liquids, gases, and vapors, and liquid levels. There is also a discussion of devices used to measure the compositions of liquids and gases and the densities and moisture contents of gases. Author

N64-15608 Joint Publications Research Service, Washington, D.C.
SPACE PHOTOGRAPHY
V. I. Sukhov 26 Feb. 1964 6 p Transl. into ENGLISH of a chapter from "Aerokartografiya nashikh dney", Moscow, 1963 p 31–34
(JPRS-23410; OTS-64-21661) OTS: $0.50

This report comments on photographs of the moon and the earth as taken from Soviet spaceships, and on the operational behavior of the spaceships during spaceflight and reentry. Soviet comparisons are made of the performance of several of their spaceships with the performances of several U.S. spacecraft during orbital flight, reentry, and landing. C.L.W.

N64-15698 Joint Publications Research Service, Washington, D.C.
HIGH-PRECISION NUCLEAR METER FOR MEASURING MAGNETIC FIELD STRENGTH
Ye. Ye. Bogatyrev 26 Feb. 1964 20 p refs Transl. into ENGLISH of an article from Tr. Vses. Nauchn.-Issled. Inst. Metrol. (Leningrad), v. 127, no. 67, 1962 p 76–88
(JPRS-23408; OTS-64-21660) OTS: $0.50

A description is given of a magnetic field intensity meter that is based on the method of nuclear magnetic resonance. The device permits the conduct of measurement of field strength in the range 20 to 2000 ka/m (250 to 25,000 oersteds) with an error of around 0.003% to 0.005%. The sources of measurement errors are considered, and results are adduced of an experimental study conducted on the meter. Author

N64-15711 Phillips Petroleum Co., Idaho Falls, Idaho Atomic Energy Div.
ARMF II REGULATING ROD READOUT AND SHIM ROD DRIVE AND POSITION DISPLAY
R. I. Little AEC National Reactor Testing Station, 25 Sep. 1963 37 p refs
(IDO-16898) OTS: $0.75

A description of the digital readout and drive portion of the Advanced Reactivity Measurement Facility II is presented along with the philosophy used in selecting the system block diagram and components, accuracy considerations, and a preliminary evaluation of performance and usability. Author

N64-15714 Joint Publications Research Service, Washington, D.C.
UNDERWATER ROBOTS
N. V. Vershinskiy *In its* New Develop. in the Earth Sci. 26 Feb. 1964 p 1–7 refs (See N64-15713 07-01) OTS: $0.50

A combination of a television mount with a remote-controlled manipulator is described. This instrument is designed for deepwater surveys. R.T.K.

N64-15722 India. Dept. of Atomic Energy, Bombay
THE PERFORMANCE OF UVISPEK SPECTROPHOTOMETER IN THE REGION 220 mμ TO 500 mμ
B. N. Srinivasan 1963 14 p refs
(AEET/ANAL/18)

The accuracy and reproducibility of the Uvispek spectrophotometer was determined employing a standard alkaline solution of potassium chromate. The standard deviation values are compared with the available data obtained on several Cary and Beckman instruments in the region 220 to 500 mμ. The spectrum of alkaline potassium chromate shows a new absorption peak at 210 mμ having $\log_{10} e = 4.10$. Author

N64-15796* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
RESPONSE OF MODIFIED REDHEAD MAGNETRON AND BAYARD-ALPERT VACUUM GAUGES ABOARD EXPLORER XVII
G. P. Newton, D. T. Pelz, G. E. Miller, and R. Horowitz Feb. 1964 13 p refs
(NASA TN D-2146)

Two Redhead and two Bayard–Alpert gages were used in the satellite Explorer XVII to measure the density, pressure, and temperature of the earth's upper atmosphere. Gage pressures from 10^{-6} to 10^{-10} torr (a function of satellite attitude and velocity, and of certain atmospheric parameters) were measured over the altitude range from 260 to 900 km. During the spin period of 0.67 sec, the gages recorded pressure changes as large as a factor of 30 (e.g., from 3×10^{-9} to 8×10^{-8} torr). Comparison of the independent gage outputs yielded values in good agreement with kinetic theory predictions. Author

N64-15834 Hanford Atomic Products Operation, Richland, Wash.
THE MEASUREMENT OF METAL TEMPERATURE BY AN ELECTROMAGNETIC INDUCTION METHOD
H. L. Libby 12 Aug. 1963 39 p refs
(Contract AT(45-1)-1350)
(HW-79621) OTS: $0.75

The basic principles of inductive thermometry are outlined, and their relationship to the principles of electromagnetic methods of nondestructive testing is described. Measured values of the impedance of long and short solenoids with conducting cores are shown and compared with calculated values for the infinitely long solenoid. It is shown that the impedance loci for varying core conductivity for the short solenoid differ from that of the calculated loci for the infinitely long coil in that the ratio of maximum resistance change to maximum reactance change decreases as the solenoid shortened. An application of the principles of inductive thermometry is described in which fabricated nonbonds between the aluminum jacket and uranium core of a nuclear fuel element were detected. The major difficulty encountered with the inductive thermometer was the undesired effect resulting from temperature change of the sensing coil. Author

N64-15881* National Bureau of Standards, Boulder, Colo. Cryogenic Engineering Lab.
THE PERFORMANCE OF POINT LEVEL SENSORS IN LIQUID HYDROGEN
D. A. Burgeson, W. G. Pestalozzi, and R. J. Richards [1963] 19 p refs Prepared for the Cryog. Eng. Conf., Boulder, Colo., Aug. 19–21, 1963
(NASA Order R-45)
(NASA CR-55328; NBS-R-292) OTS: $1.60 ph, $0.80 mf

Seventeen manufacturers' point sensors have been tested for repeatability and time response from 1 atmosphere to 13.6 atmospheres. An analysis of the results by type and operating procedure is included. Possible application of point-level sensors to space systems is summarized. Author

N64-15921* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
VIBRATION ISOLATION OF SATELLITE TAPE RECORDERS
Joseph H. Conn Washington, NASA, Feb. 1964 12 p
(NASA TM X-942) OTS: $0.50

A standardized method of shock and vibration isolation for satellite tape recorders has been developed. Using readily available components, the isolators combine small size, light weight, and damping characteristics with good load-carrying and elastomeric properties. This system is now being used in the International Satellite UK-2 and will be used in the Orbiting Solar Observatory (S-57 model). It may be applied to many other components, such as electron tubes, bearing assemblies, and sensitive electronic assemblies. Author

N64-16000 Pratt and Whitney Aircraft, Middletown, Conn.
THERMOCOUPLE DEVELOPMENT LITHIUM-COOLED REACTOR EXPERIMENT
Salvatore Fanciullo 5 Mar. 1964 157 p refs
(Contract AT(30-1)-2789)
(PWAC-422) OTS: $2.75

A refractory metal thermocouple consisting of W-5 Re/W-26 Re grounded junction thermoelements and alumina insulation, and clad with a 1/8-in.-OD, Cb-1 Zr-to-type 316 stainless steel coextruded sheath was selected to be the primary temperature sensor on the Lithium-Cooled Reactor Experiment (LCRE). Additional thermocouple combinations studied were Chromel/Alumel, W-3 Re/W-25 Re, molybdenum/columbium, and Mo/W-26 Re. This report contains the results of work performed to improve thermocouple quality and fabrication techniques. Author

N64-16054 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
TRANSDUCERS FOR MECHANICAL PARAMETERS OF MACHINES
N. P. Rayevskiy 3 Sep. 1963 307 p refs Transl. into ENGLISH of the book "Datchiki Mekhanicheskikh Parametrov Mashin" Moscow, Izd. Akad. Nauk SSSR, 1959 p 1–187
(FTD-TT-62-1334/1+2; AD-422948)

The contents of this book cover the following: (1) the metrological characteristics of mechanical parameters; (2) the use of direct-conversion transducers and of indirect-conversion transducers for measuring mechanical quantities; (3) the measurement of such basic parameters as displacement, linear velocities, angular velocities, accelerations, force, and torque; (4) experimental problems in recording trajectories of two-dimensional motion, such as recording the trajectory of the center of a connecting-rod bearing in a crankshaft-connecting-rod installation; and (5) the experimental determination of reduced moments of inertia for machinery. Amplifying equipment, recording instruments, and the processing of oscillograms are discussed. I.v.L.

N64-16067* National Research Corp., Cambridge, Mass.
DEVELOPMENT OF SATELLITE INSTRUMENTATION REFERENCE STANDARDS AND CALIBRATION EQUIPMENT FOR MEASUREMENTS AT VERY LOW GAS DENSITIES Phase 1 Report
Jonathan R. Roehrig 24 Oct. 1960 32 p refs
(NASA Contract NAS5-14)
(NASA CR-55789; NRC Res. Proj. 43-1-134) OTS: $3.60 ph, $1.16 mf

The results of a study of upper-atmosphere sensors and calibration methods are presented. The study covers two problems—the investigation of the low-gas-density sensor and the study of calibration methods. R.T.K.

16 LIFE SCIENCES

Includes biology; exobiology; physiology; medicine; life support systems; radiation effects on biological systems; and space sickness. *For related information see*: 14 Human Behavior; and 28 Space Radiation.

N64-15034 Deutsche Versuchsanstalt für Luft- und Raumfart, Bad Godesberg (W. Germany) Inst. für Flugmedizin
PRESENTATIONS OF CO-WORKERS OF THE INSTITUTE FOR FLIGHT-MEDICINE OF THE DVL IN LONDON AND PARIS (1960 AND 1961) [VORTRAGE DER MITARBEITER DES INSTITUTS FUR FLUGMEDIZIN DER DVL IN LONDON UND PARIS (1960 UND 1961)]
Oct. 1963 154 p refs Papers in language of congress at which presented: 11 in ENGLISH, 2 in FRENCH; each has a GERMAN version
(DVL-205) Available from Vereinigte Universitäts- U. Fachbuchhandlungen, R.-Wagner-Str. 1, Cologne, W. Germany

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N64-15035 Deutsche Versuchsanstalt für Lüft- und Raumfahrt, Bad Godesberg (W. Germany) Inst. für Flugmedizin
MEASURING THE INDIVIDUAL STRESS-SENSITIVITY BY MEANS OF OXYGEN-WANT
K. E. Klein, H. Brüner, and D. Jovy *In its* Presentation of Co-Workers of the Inst. for Flight-Med. of the DVL in London and Paris (1960 and 1961) Oct. 1963 p 5–15 refs In ENGLISH and GERMAN Presented at the 5th European Congr. of Aviation Med., London, 1960 (See N64-15034 07-16)

Pilots were tested, with regard to their efficiency under oxygen deficiency, up to the moment of beginning loss of muscular tonus. Based upon the results of the test, the pilots were grouped into types A and B. Pilots of group A had an average of 6 to 7 minutes until the onset of central-nervous-system functional disturbances. Pilots of group B had an average onset of considerably more than 12 minutes. After the subjects were placed into groups A and B, they were submitted once more to 5 minutes of oxygen deficiency. Eosinophiles were counted up to 4 hours after exposure to the stressor. It is shown that in persons of the more stable-B type, the decrease in eosinophiles was only half as much as compared to the more vegetatively unstable A-types, and the reincrease started earlier. There is a significant difference between the two groups ($P < 0.01$). In general, the response of the eosinophile cells is considered to be a symptom of the organism's reaction to an unspecified stressor, and there exist numerous indications of adreno–cortex activitation, i.e., output of cortical hormones. However, adrenaline, serotin, etc., also play a part. The test demonstrated a method by which pilots who have a lower stress sensitivity can be selected.
I.v.L.

N64-15036 Deutsche Versuchsanstalt für Luft- und Raumfahrt, Bad Godesberg (W. Germany) Inst. für Flugmedizin
MODIFICATION OF THE INDIVIDUAL STRESS-SENSITIVITY BY ADAPTATION TO OXYGEN-WANT IN THE LOW-PRESSURE CHAMBER
H. Brüner, K. E. Klein, and D. Jovy *In its* Presentation of Co-Workers of the Inst. for Flight-Med. of the DVL in London and Paris (1960 and 1961) Oct. 1963 p 16–28 refs In ENGLISH and GERMAN Presented at the 5th European Congr. of Aviation Med., London, 1960 (See N64-15034 07-16)

Modification of the individual stress sensitivity by adaptation to oxygen deficiency in a low-pressure chamber was investigated. Results indicate that it is possible to improve considerably the altitude tolerance of a pilot by an intermittent oxygen-deficiency exposure daily of only 1/2 hour for a 4-week

period, without respiration, circulation, erythrocytes, and hemoglobin showing changes up to this moment. However, a simultaneous, strong decrease in the adreno–cortical reaction points to the fact that changes have occurred in the organism that necessitate a much lesser adrenal activation than before, under equally unspecific terms. It can be summarized that a person with an oxygen-deficiency shows sensitivity toward an unspecified stressor, regardless of whether this sensitivity depends on a different functional state of the adreno–cortex, as in the first adaptation phase of the individual, or on a probably different quality of cell metabolism as in an unadapted type, with an average of 6 to 7 minutes until the onset of central-nervous-system functional disturbances, and as in an unadapted type where the average onset time of such disturbances is more than 12 minutes. I.v.L.

N64-15037 Deutsche Versuchsanstalt für Luft- und Raumfahrt, Bad Godesberg (W. Germany) Inst. für Flugmedizin
THE VARIOUS CONDITIONS OF THE "ALKALI RESERVE" IN OXYGEN-DEFICIENCY [LES DIVERS COMPORTEMENTS DE LA "RESERVE EN ALCALI" EN MANQUE D'OXYGENE]
H. Kunzmann *In its* Presentation of Co-Workers of the Inst. for Flight-Med. of the DVL In London and Paris (1960 and 1961) Oct. 1963 p 28-33 in FRENCH and GERMAN Presented at the 5th European Congr. of Aviation Med., London, 1960 (See N64-15034 07-16)

The hyperventilation alkalosis, associated with the reduction of the partial pressure of carbon dioxide, was common to all cases studied. However, in 30% of the test subjects, the acid-base equilibrium was not only affected by the hyperventilation alkalosis but also by a rise in bicarbonate concentration, which caused an increase in the entire carbon dioxide content. A shifting to the left of the oxygen-bonding curve is associated with an alkalinization of the blood. Since it is known that the decisive criterion is not the sufficient oxygen uptake but the oxygen delivery to the tissue during reduced pressure, a compensation must be attempted, i.e., a shifting to the right of the oxygen-bonding curve by a reduction in the hydrogen concentration. This occurs in people acclimated to high altitudes. Acclimatization to high altitude does not depend on the heart or the lungs; it is primarily due to changes in blood composition. I.v.L.

N64-15038 Deutsche Versuchsanstalt für Luft- und Raumfahrt, Bad Godesberg (W. Germany) Inst. für Flugmedizin
THE ENCYMATICAL INCORPORATION OF IRON INTO PROTOPORPHYRIN UNDER CONDITIONS OF OXYGEN-WANT
G. Schafer and K. H. Weiner *In its* Presentation of Co-Workers of the Inst. for Flight-Med. of the DVL in London and Paris (1960 and 1961) Oct. 1963 p 34–41 In ENGLISH and GERMAN Presented at the 5th European Congr. of Aviation Med., London, 1960 (See N64-15034 07-16)

The enzymatical incorporation of iron into protoporphyrin under conditions of oxygen deficiency in rabbits was investigated. Results are summarized as follows: The activity of heme synthesis in the liver of animals under hypoxia is visibly increased compared to the same activity under normal conditions. After the homogenates had been exposed to air for several hours, the activity had decreased; it was noted that the activity of the liver, bone marrow, and spleen under oxygen-deficiency conditions was much lower than under normal conditions. It is not known whether protoporphyrin or protoporphyrinogen is physiologically the primary substance for the conversion of iron into hemoglobin. The following conclusions can be drawn from these results: (1) The heme synthesis activity of the liver, spleen, and bone marrow is increased by oxygen deficiency. (2) Hemoglobin will probably be synthesized by smaller structural elements under conditions of oxygen deficiency. (3) An adaptation of the organism to chronic oxygen deficiency is combined with an increase in activity or increase (of the specific enzyme protein) of the heme synthesis. I.v.L.

N64-15039 Deutsche Versuchsanstalt für Luft- und Raumfahrt, Bad Godesberg (W. Germany) Inst. für Flugmedizin
EFFECTS OF HYPOXIA ON THE ALBUMIN METABOLISM IN MAMMIFER ORGANISMS ILLUSTRATED BY WAY OF GLUTAMIC ACID-OXALIC ACETOUS ACID-TRANSAMINASIS IN SERUM
G. Schafer and K. H. Weiner *In its* Presentation of Co-Workers of the Inst. for Flight-Med. of the DVL in London and Paris (1960 and 1961) Oct. 1963 p 42–50 In ENGLISH and GERMAN Presented at the 5th European Congr. of Aviation Med., London, 1960 (See N64-15034 07-16)

The influence of continuous inspiratory hypoxia of more than 980 hours on those intermediary modifications of albumin metabolism in young rabbits, which manifest themselves in the changes in activity of glutamic acid-oxalacetic acid-transaminase in serum, was investigated. The strong fluctuations in the S-G-O-T-level (serum-glutamic acid-oxalacetic acid-transaminase level) at the beginning of hypoxia and during the transition period to normal conditions indicate a badly adapted regulation of the metabolism in the rabbits. After transition to normal oxygen conditions, a strong increase in transaminase activity in serum took place. It was only after 17 days that the transaminase level gradually started to decrease, but it was still visibly increased 42 days after exposure to oxygen deficiency. These findings support the theory that the albumin metabolism had not yet normalized at this time, whereas the hemoglobin contents and the blood picture had returned to their original values. Also, tests on adult rabbits are discussed. I.v.L.

N64-15040 Deutsche Versuchsanstalt für Luft- und Raumfahrt, Bad Godesberg (W. Germany) Inst. für Flugmedizin
HYPERELECTROLYTAEMIA AND INTRAVASCULAR FORMATION OF GAS BUBBLES IN RAPID DECOMPRESSION
O. Wunsche and H. Hartmann *In its* Presentation of Co-Workers of the Inst. for Flight-med. of the DVL in London and Paris (1960 and 1961) Oct. 1963 p 51–59 In ENGLISH and GERMAN Presented at the 5th European Congr. of Aviation Med., London, 1960 (See N64-15034 07-16)

Albino rats that have been premedicated with an electrolyte solution containing 0.4% $KHCO_3$, 0.2% CaI_2, and 0.2% $NaHCO_2$ show fewer intravascular air bubbles after decompression from 0 to 18,000 m (60,000 ft) altitude than untreated controls. Gas bubbles are found in 80% to 90% of the untreated rats, but they are observed in only 10% to 20% of the premedicated animals. The electrolyte solution causes an increase of the sodium, potassium, and calcium level in the serum, as well as dehydration. The origin of the intravascular air bubbles after rapid decompression is discussed. It is suggested that the greater part of the air bubbles probably does not originate from gas liberated from the blood, but from air penetrating the vascular system from the alveoli. This can be expected only at a positive pressure of 80 mm Hg within the alveoli. Author

N64-15041 Deutsche Versuchsanstalt für Luft- und Raumfahrt, Bad Godesberg (W. Germany) Inst. für Flugmedizin
MEASURING AND CRITICAL EXAMINATION OF THE INFLUENCE OF DRUGS ON THE PERFORMANCE ABILITY OF AVIATORS
D. Jovy, H. Bruner, and K. E. Klein *In its* Presentation of Co-Workers of the Inst. for Flight-Med. of the DVL in London and Paris (1960 and 1961) Oct. 1963 p 60–73 refs In ENGLISH and GERMAN Presented at the 5th European Congr. of Aviation Med., London, 1960 (See N64-15034 07-16)

The influence of antiemetics, tranquilizers, sedatives, and analeptics on the performance ability of pilots was investigated. The testing procedure enabled the determination of all decisive factors of psychomotor performance, such as coordination and reaction, intensity and duration of attention, as dependent on disposition and will-power, in one sum total. In this test procedure, the person has to choose from a pool of differently sized pellets a suitable one to place into a correspondingly sized opening of a rhythmically revolving roll. The speed of the roll and, thus, the release of the individual openings, can be regulated. The speed may be increased up to 60 pellets to be inserted per minute, or be demanded for a certain time as a continuous maximum efficiency. The test results are recorded by an indicator that sets a mark for each correctly inserted pellet. For evaluation, the number of such marks/min in percent is taken as a basis for computing a so-called psychomotor-performance index. I.v.L.

N64-15042 Deutsche Versuchsanstalt für Luft- and Raumfahrt, Bad Godesberg (W. Germany) Inst. für Flugmedizin
DECOMPRESSION SICKNESS AND AIR EMBOLISM
H. Hartmann and O. Wunsche *In its* Presentation of Co-Workers of the Inst. for Flight-Med. of the DVL in London and Paris (1960 and 1961) Oct. 1963 p 74–81 In ENGLISH and GERMAN Presented at the Intern. Congr. of Aviation and Cosmonautical Med., Paris, 1961 (See N64-15034 07-16)

When decompression experiments that have been made on rats are applied to man, the results indicate the following: All symptoms that occur within a few seconds after decompression are, in all probability, caused by pulmonary air embolism, whereas at least a few minutes are required for the intravascular liberation of the physically dissolved nitrogen. Special danger exists for persons when the ratio of the inspiratory and expiratory period is shifted toward a prolonged expiratory phase. This danger applies to all emphysematous persons, as well as to all persons with an increased respiratory resistance due to spastically changed bronchi and bronchioles. Not only are the rapidity of the pressure drop and the amount of the pressure difference of importance but also of importance is the respiratory phase. The most unfavorable case is a depression that occurs when the glottis is closed and the thorax is in the inspiratory position. When a pressure drop is anticipated, (for instance, when a person jumps from a plane in which the interior cabin pressure is higher than the ambient pressure), the risk of air embolism could be diminished if the person exhales before the cabin seat is ejected. I.v.L.

N64-15043 Deutsche Versuchsanstalt für Luft- und Raumfahrt, Bad Godesberg (W. Germany) Inst. für Flugmedizin
ON THE INFLUENCE OF OXYGEN-WANT ON THE BIOSYNTHESIS OF HEME FORMATION
G. Schafer and H. Weiner *In its* Presentation of Co-Workers of the Inst. for Flight-Med. of the DVL in London and Paris (1960 and 1961) Oct. 1963 p 82–87 In ENGLISH and GERMAN Presented at the Intern. Congr. of Aviation and Cosmonautical Med., Paris, 1961 (See N64-15034 07-16)

The effect of oxygen deficiency on the biosynthesis of heme formation was investigated. The reaction was effected *in vitro* by the incubation of radioactive iron and protoporphyrin in the presence of organ homogenate, in which the enzyme has been enriched by pretreatment. The enzyme activity was measured by the amount of incorporated iron (Fe^{59}). The radioactivity of the Fe^{59} heme was measured in a scintillation counter. Results indicate that there is a regulation system already present in this early phase of erythropoiesis, which provides an effective response to the actual oxygen requirement of the specific cellular tissue, particularly because nearly all parenchymatous organs are capable of this reaction. However, it is not clear how the heme, which had been formed in the specific organs, is incorporated into the maturing red-blood cell. I.v.L.

N64-15044 Deutsche Versuchsanstalt für Luft- und Raumfahrt, Bad Godesberg (W. Germany) Inst. für Flugmedizin
SOME QUANTITATIVE AND MORPHOLOGICAL CHANGES OF HUMAN BLOOD UNDER DIFFERENT STRESSES [DES CHANGEMENTS QUANTITATIFS ET MORPHOLOGIQUES DU SANG HUMAIN SOUS DES CHARGES DIFFERENTES]
H. Kunzmann *In its* Presentation of Co-Workers of the Inst. for Flight-Med. of the DVL in London and Paris (1960 and 1961) Oct. 1963 p 88–93 In FRENCH and GERMAN Presented at the Intern. Congr. of Aviation and Cosmonautical Med., Paris, 1961 (See N64-15034 07-16)

The erythrocyte count was elevated by physical work and oxygen-deficiency stress. However, in the case of oxygen deficiency, the maximum in the count occurred during exposure to the deficiency, and the counts after the end of the test were less than that of the equilibrium count. During physical work, the highest counts were obtained after the end of the test, and were further elevated after rest. An increase in reticulocytes, perhaps indicating an increased activity of the erythropoetic system, occurred only in oxygen-deficiency tests. The total number of leucocytes during each of the stresses (physical work, acute oxygen-deficiency, and short-time acceleration in a centrifuge) increased. This increase continued five minutes after the end of the test, and the count was above the equilibrium level an hour later. The relative count of the neutrophilic nuclear-segmented granulocytes remained almost constant for the duration of the test. Although a partial lymphocyte increase occurred in all of the stress tests, a persistent lymphopenia was observed with increasing test duration. Parallel to this, the eosinophile count, after an intially short time increase, changed. The above-mentioned changes indicate a change in the white-cell blood picture after a multiple distribution of corticosteroids, and can be a reflection of the compensatory hormonal adaptation. Transl. by I.v.L.

N64-15045 Deutsche Versuchsanstalt für Luft- und Raumfahrt, Bad Godesberg (W. Germany) Inst. für Flugmedizin
ON THE UNSPECIFIC STIMULATION OF THE ORGANISM BY VARIOUS STRESSORS
D. Jovy, H. Bruner, and K. E. Klein *In its* Presentation of Co-Workers of the Inst. for Flight-Med. of the DVL in London and Paris (1960 and 1961) Oct. 1963 p 94–108 refs In ENGLISH and GERMAN Presented at the Intern. Congr. of Aviation and Cosmonautical Med., Paris, 1961 (See N64-15034 07-16)

The unspecific stimulation of the organism by various stressors was investigated. Results indicate that the unspecific adaptive system actually responded markedly in the same persons under all chosen kinds of stress, no matter whether the stressor was oxygen deficiency, muscular work, heat, cold, or acceleration. Even acceleration, which might also be considered a specific stressor, also leads, to eosinopenia and increased corticoid output. These findings show that the unspecific adaptive mechanism is of basic importance to resistance against all stressors. The main factor should be the indirect supporting role played by the corticoids. As biological catalyzers, they enable and favor metabolic processes, and promote the attempt of the organism to return to a normal state, regardless of the type of the previous disturbance. I.v.L.

N64-15046 Deutsche Versuchsanstalt für Luft- und Raumfahrt, Bad Godesberg (W. Germany) Inst. für Flugmedizin
THE IMPORTANCE OF A LONG-TERM SOJOURN IN HIGH MOUNTAIN REGION (ANDES MTS.) FOR THE CONDITIONING OF FLYING PERSONNEL

K. E. Klein, H. Bruner, and D. Jovy *In its* Presentation of Co-Workers of the Inst. for Flight-Med. of the DVL in London and Paris (1960 and 1961) Oct. 1963 p 109–121 refs In ENGLISH and GERMAN Presented at the Intern. Congr. of Aviation and Cosmonautical Med., Paris, 1961 (See N64-15034 07-16)

A sojourn of several weeks at an altitude of 6,200 m, in a changing climate, and the performance of moderate physical work induce a marked adaptation in the unspecific hypophyseo–adrenocortical system. In addition, they distinctly improve the reaction of circulation, respiration, metabolism, and other physiological functions to different stress situations. These results show an increased resistance against stressors, which is of importance to flying performance and survival, at least in emergency situations. I.v.L.

N64-15047 Deutsche Versuchsanstalt für Luft- und Raumfahrt, Bad Godesberg (W. Germany) Inst. für Flugmedizin

PERCEPTION PROBLEMS IN HIGH-SPEED FLIGHT

Siegfried Fichtbauer *In its* Presentation of Co-Workers of the Inst. for Flight-Med. of the DVL in London and Paris (1960 and 1961) Oct. 1963 p 122–133 refs in ENGLISH and GERMAN Presented at the Intern. Congr. of Aviation and Cosmonautical Med., Paris, 1961 (See N64-15034 07-16)

This report deals with visual-perception factors associated with the prevention of supersonic-aircraft collisions. These factors are: (1) the time required for the perception process connected with judging the flight attitude of the other aircraft and taking preventive action; (2) the turning radius, at Mach-3 speed, which is still tolerable to passengers; (3) the maximum distance at which a pilot with normal eyesight can detect another aircraft; and (4) the visibility at cruising level. A discussion of these factors leads to the conclusion that in order to have a fully effective air-traffic control system, it will be necessary to divide air space into two or three regions, e.g., one for prop aircraft, another for subsonic jet aircraft, and a third for the supersonic aircraft. The different regions should be controlled by different types of radar. I.v.L.

N64-15051 Naval Air Development Center, Johnsville, Pa. Aviation Medical Acceleration Lab.

A THEORY OF ION TRANSPORT ACROSS CELL SURFACES BY A PROCESS ANALOGOUS TO ELECTRON TRANSPORT ACROSS LIQUID-SOLID INTERFACES

Freeman W. Cope 6 Dec. 1963 20 p refs
(NADC-MA-6325; Rept. 24; AD-428119)

A kinetic theory of ion transport across cell surfaces has been developed in a form analogous to the kinetic theory of electron transport across solid–liquid interfaces of biological particles. The ionic theory is based on the observation that, at least in one instance, the voltage–current behavior for ion conduction across a cell surface is describable by the Tafel equation, in analogy to the conduction of electrons across solid–liquid interfaces. The theory predicts that the kinetics of ion transport across cell surfaces should conform to the Elovich rate equation, which is shown to be true for various experimental data. Author

N64-15052 Naval Air Development Center, Johnsville, Pa. Aviation Medical Acceleration Lab.

FLASHBLINDNESS: A PROBLEM OF ADAPTATION

J. H. Hill and Gloria T. Chisum 4 Dec. 1963 12 p refs Presented at the ACLANT Symp. for NATO Med. Officers and Health Ministers held at the Naval Med. Res. Inst., Nat. Naval Med. Center, Bethesda, Md., 29–30 Oct. 1963
(NADC-MA-6327; AD-429241)

Flashblindness, the temporary reduction in visual sensitivity due to exposure to a high-intensity flash, is a potential problem to pilots of modern high-performance aircraft. Some of the possible solutions to this problem are presented and evaluated in this paper. A brief description of the visual processes affected is given. The relation of light adaptation and dark adaptation of the eye to the changing lighting conditions and the recovery of sensitivity to a functional level are discussed. The suitability of fixed density goggles as a protective system is examined, and the results of the simulation of protective devices with closing times of 33 μsec, 165 μsec, and 9.8 msec are reviewed. Eye patch studies are also discussed. Author

N64-15093 Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio

ANALYSIS OF LIMITING THERMAL CONDITIONS ENCOUNTERED BY A MANNED SPACE SUIT IN ORBIT Technical Documentary Report, May 1959–Jul. 1963

Thomas F. Irvine, Jr. (N.Y. State U.) and Kenneth R. Cramer Nov. 1963 26 p refs
(AMRL-TDR-63-102; AD-429184) OTS: $0.75

Three thermal problems have been examined that occur in the design of space suits to be used when personnel are outside the parent vehicle. The first concerns the time–temperature variation of an infinite thermal conductivity suit exposed to extreme conditions of heating and cooling. The second is related to temperature differences that may occur from the top to the bottom of the suit, thereby causing physiological discomfort. Finally, a scheme was examined whereby these temperature differences might be ameliorated by circulating a fluid in passages behind the suit material. Author

N64-15107 Naval Air Engineering Center, Philadelphia, Pa. Air Crew Equipment Lab.

RESEARCH IN LIFE SUPPORT SYSTEMS FOR AIRBORNE AND SPACE VEHICLES

Roland A. Bosee In ONR Solution to Navy Probl. through Advanced Technol. [1963] p 89–97 (See N64-15101 07-01) OTS: $5.00

Results of investigations in human engineering, altitude tolerance, atelectasis, and negative impact are reported. Other problems discussed are: environmental protection; aeroembolism with respect to the projected Apollo missions; and the likelihood that the combined stresses of launch acceleration, the 100% oxygen in the ambient environment, and reentry acceleration might cause atelectasis during projected Gemini missions. R.T.K.

N64-15153 Joint Publications Research Service, Washington, D.C.

THE RADIOSENSITIVITY OF BIRDS

10 Feb. 1964 5 p refs Transl. into ENGLISH of an article from Biol. Deystviye Radiatsii (Lvov), no. 1, 1962 p 81–83
(JPRS-23169; OTS-64-21531) OTS: $0.50

Five species of birds were X-irradiated to determine, within a 30-day period, the lethal doses in 50% of the test animals. The great radiosensitivity in birds varies only slightly (400 to 600 r) among the species studied. There is impairment of motor coordination, of pecking reflex, and of flight orientation. R.L.K.

N64-15165 Federal Aviation Agency, Oklahoma City, Okla. Civil Aeronautical Research Inst.

THE PERCEPTION OF DEPTH FROM BINOCULAR DISPARITY

Walter C. Gogel May 1963 12 p refs
(CARI-63-10)

This study was concerned with the factors involved in the perception of depth from binocular disparity. A binocularly observed configuration of constant convergences, constant visual size, and having constant binocular disparities was made to appear at two different distances in a monocularly observed field-of-view. Both the perceived frontoparallel sizes and the perceived depth within the configuration were measured by means of a kinesthetic (hand) adjustment. It was found that the perceived frontoparallel size and the perceived depth in the binocularly observed configuration increased as the perceived distance of the configuration increased. It is concluded that the perceived depth resulting from a constant binocular disparity will differ depending upon the perceived size per unit of visual angle of frontoparallel extents in its depth vicinity. Author

N64-15167 Joint Publications Research Service, Washington, D.C.
THE APPLICATION OF CYBERNETICS IN PEDAGOGY
P. R. Atutov *In its* Cybernetics in Pedagogy and Commun. 11 Feb. 1964 p 1–9 refs Transl. into ENGLISH from Sov. Pedagogika (Moscow), v. 26, no. 8, 1962 p 147–152 (See N64-15166 07-01) OTS: $0.75

Certain methodological problems are discussed in an attempt to ascertain the possibilities of using cybernetics in pedagogy. For the broad introduction of new methods into pedagogical research, it is necessary to achieve a careful study of the qualitative aspects of the pedagogical process, with an aim toward revealing the general tendencies in its development. In order to understand the entire process of the movement as a whole and to foresee its further development, it is necessary to know how to determine the leading tendency and to isolate it from the variegated mass of individual instances, without moving into the foreground the attendant and the accidental. For the successful solution of these tasks, it is necessary to have creative scientific groups made up of mathematicians, educators, psychologists, and engineers. P.V.E.

N64-15169 Joint Publications Research Service, Washington, D.C.
THE SPEECH SIGNAL IN CYBERNETICS AND COMMUNICATIONS
A. A. Pirogov *In its* Cybernetics in Pedagogy and Commun. 11 Feb. 1964 p 17–19 ref Transl. into ENGLISH from Elektrosvyaz (Moscow), no. 8, 1963 p 75 (See N64-15166 07-01) OTS: $0.75

A review is presented of a book entitled, "The Speech Signal in Cybernetics and Communications: The Transformation of Speech as Applicable to the Tasks of the Technology of Communications and Cybernetics." P.V.E.

N64-15181* National Research Corp., Cambridge, Mass. Research Div.
EFFECTS OF SIMULATED SPACE ENVIRONMENTS ON THE VIABILITY OF MICROORGANISMS Final Report, 15 Apr. 1961-30 Apr. 1963
Gerald J. Silverman (MIT), Rosario P. Giammanco, Norman S. Davis (MIT), Frank C. Benner, and Cecil G. Dunn (MIT) 18 Dec. 1963 34 p refs
(NASA Contract NASr-41)
(NASA CR-55288) OTS: $3.60 ph, $1.22 mf

Spores of five test organisms, *Bacillus subtilis* var. *niger*, *Bacillus megaterium*, *Bacillus stearothermophilus*, *Clostridium sporogenes*, and *Aspergillus niger*, and soils were exposed while under ultrahigh vacuum to temperatures of from −190° to +170° C for 4 to 5 days. Up to a temperature of 25°C, no loss in viability of the test spores was noted when compared to original populations maintained at room temperature and atmospheric pressure over a desiccant. At elevated temperatures, differences in resistivity occurred so that at 88° C only *B. subtilis* var. *niger* and *A. niger* survived in appreciable numbers. At 107° C, only *A. niger* spores survived, but none were recoverable after exposure to 120° C. In comparison, *B. subtilis* var. *niger* survived at atmospheric pressure and 90° C for 5 days, but none of the other spores were viable after 24 hours. Author

N64-15202* California U., Berkeley Lawrence Radiation Lab.
PRELIMINARY REPORT ON STUDIES OF ERYTHROPOIESIS AND ADRENAL-CORTICAL FUNCTION ON MT. EVEREST
William E. Siri *In its* Semiann. Rept.–Biol. and Med., Spring 1963 p 1–11 refs (See N64-15201 07-01) OTS: $2.75
(Supported by NASA, AEC, NSF, and AFOSR)

The following were studied: (1) the rate of plasma-iron disappearance and erythropoietic activity, (2) examination of blood smears for reticulocyte counts, (3) hemoglobin concentration, (4) hematocrit and red blood cell count, (5) platelet count, (6) adrenal-corticalsteroid analyses and urine chemistry, (7) basal heart rate, (8) resting blood pressure, (9) the recovery patterns of both heart rate and blood pressure following exercise, and (10) weight loss during the expedition. R.T.K.

N64-15203* California U., Berkeley Lawrence Radiation Lab.
STUDIES ON THE MAMMALIAN RADIATION SYNDROME WITH HIGH-ENERGY PARTICULATE RADIATION I. DIFFERENCE IN INJURY MODE AND ITS DOSE RATE DEPENDENCE FOR 100 kVp X RAYS AND 730 MeV PROTONS
James K. Ashikawa, Charles A. Sondhaus, Cornelius A. Tobias, Clyde Greenfield, and Jerry Howard *In its* Semiann. Rept.—Biol. and Med., Spring, 1963 p 12–18 refs (See N64-15201 07-01) OTS: $2.75
(Supported by NASA)

In proton-irradiated mice (after various doses of proton radiation at 1,000 and 100 rad/min), peak mortality occurred at 4 to 6 days postirradiation. For mice irradiated with 30-day lethal doses of 100 kVp X-rays, peak mortality occurred at 12 to 14 days postirradiation. A fivefold increase in dose rate from 20 to 100 rad/min produced few deaths from the gut syndrome, but the higher dose rate did effect an enhancement of the marrow syndrome similar to that observed for gut syndrome with proton irradiation. The cumulative mortality data for proton irradiation indicated a marked increase in incidence and abruptness of 4- to 6-day gut deaths in animals receiving a proton dose at 1,000 rad/min, compared to those irradiated at 100 rad/min. At 5 days, 30% mortality was observed in the 100 rad/min animals, whereas 60% mortality had already been reached in the 1,000 rad/min groups, although the 30-day mortality was the same in both groups for a given total dose. For X-ray irradiation, 10% 6-day deaths were observed at 20 rad/min, whereas 30% 6-day deaths were observed at 100 rad/min. P.V.E.

N64-15204* California U., Berkeley Lawrence Radiation Lab.
DEPTH DOSE IN LARGE PHANTOMS IRRADIATED OMNIDIRECTIONALLY WITH HIGH-ENERGY PROTONS
Charles A. Sondhaus, Palmer G. Steward, and Roger W. Wallace *In its* Semiann. Rept.—Biol. and Med., Spring, 1963 p 19–28 refs (See N64-15201 07-01) OTS: $2.75
(Supported by NASA)

The preliminary results are presented of computer calculations carried out to predict approximately the dose, particle energy, and linear energy transfer (LET) distribution in an omnidirectionally irradiated spherical phantom as a function

of incident primary-particle energy and of sphere diameter. The output of the computer program is in the form of depth-dose data and fraction of dose due to protons in each of several energy intervals at each dose point in the sphere; the LET distribution is calculated from the latter at each depth. The data were calculated for tissue-equivalent spheres of diameter 5 to 100 cm, exposed omnidirectionally to monoenergetic proton fluxes of energy between 20 and 730 Mev. The curves of depth dose for a 30-cm-diam. sphere were essentially flat down to about 200 Mev, indicating that uniform whole-body exposure of large animals is possible at this energy or higher. Below the 200 Mev energy region, the ratio of surface to midline dose increases rapidly with decreasing energy and increasing sphere diameter, the midline dose from primaries alone becoming zero at the lowest energies considered.

P.V.E.

N64-15205* California U., Berkeley Lawrence Radiation Lab.
THE ALPHA-PARTICLE OR PROTON BEAM IN RADIOSURGERY OF THE PITUITARY GLAND FOR CUSHING'S DISEASE

John A. Linfoot, John H. Lawrence, James L. Born, and Cornelius A. Tobias *In its* Semiann. Rept.—Biol. and Med., Spring, 1963 p 29–40 refs (See N64-15201 07-01) OTS: $2.75 (Supported by AEC)

Recent studies of pituitary and adrenal function as well as a greater awareness of pituitary tumors in patients with bilateral adrenal hyperplasia require that the pituitary gland again be considered primarily in the treatment of Cushing's disease. Two patients, one without a demonstrable pituitary tumor and another with an ACTH-secreting pituitary adenoma, were successfully treated by pituitary irradiation with alpha particles, which were imparted extremely high energies in a large accelerator. These penetrating heavy particles provide a more satisfactory form of teletherapy than X-ray or gamma-ray sources because larger amounts of ionizing radiation can be delivered safely to the sella turcica. Author

N64-15206* California U., Berkeley Lawrence Radiation Lab.
PRELIMINARY REPORT ON HISTOPATHOLOGICAL CHANGES IN BRAIN FOLLOWING HEAVY-PARTICLE IRRADIATION

Larry W. Mc Donald, James L. Born, John H. Lawrence, and John T. Lyman *In its* Semiann. Rept.—Biol. and Med., Spring 1963 p 41–54 refs (See N64-15201 07-01) OTS: $2.75

A study of the histological changes occurring in areas of the brain nearest the pituitary (as a result of heavy-particle irradiation of the pituitary) resulted in the following observations: (1) The threshold for observable radiation changes in the cerebrum was about 4.0 krads in 11 days of alpha-particle irradiation in a series of 17 cases; greater correlation was found with an exposure of more than 5.5 krads. (2) The changes at the dose levels of 4 to 9 krads in 11 days appear related to alterations in the vasculoastrocytic unit, with early swelling of cells of the vessel walls, particularly of the small arterioles; astrogliosis was observed early but was not a prominent feature. (3) An increase in the number of PAS positive bodies was noted with a 5.6 to 9 krad exposure. (4) No definite change could be noted in the nerve cells in the dose range of 4 to 9 krads. A graft-rejection-type reaction is suggested to account for the delayed necrosis of the brain that occurred at doses above 6.0 krads with a survival of over 1,000 days.

P.V.E.

N64-15207* California U., Berkeley Lawrence Radiation Lab.
MODIFICATION OF RADIATION EFFECTS WITH MAGNETIC FIELDS

Nabil M. Amer *In its* Semiann. Rept.—Biol. and Med., Spring, 1963 p 55–58 refs (See N64-15201 07-01) OTS: $2.75 (Supported by NASA and AEC)

An investigation into the modifying effect of a constant magnetic field on the course of wing development of *Tribolium confusum* produced the following results: (1) At a given temperature and X-ray dose, a higher magnetic field produced relatively greater protective effect. (2) The magnetic field had a significantly decreasing effect on spontaneously occurring wing abnormality at 38° C but not at 30° C, where very few abnormalities were found. (3) Postirradiation protection by magnetic fields was much more marked at 38° C than at 30° C. (4) At 38° C the effect was significant at 2.2 and 3.6 kg for each X-ray level tested; at 30° C using 2.2 and 3.6 kg, pupae exposed to radiation showed no effect at all. It is concluded that postirradiation magnetic field protection is most effective where synergism between X-ray and temperature occurs.

P.V.E.

N64-15208* California U., Berkeley Lawrence Radiation Lab.
MULTICOMPARTMENT INTERPRETATION OF RADIATION-DAMAGE CURVES

Aldo Rescigno *In its* Semiann. Rept.—Biol. and Med., Spring, 1963 p 59–64 refs (See N64-15201 07-01) OTS: $2.75 (Supported by NASA and AEC)

A mathematical development is presented that can be used to obtain the relationship between an increment in radiation dosage and the increase in the number of cells (out of a group of irradiated cells) affected by the increase in radiation, where: (1) the cells are assumed to be composed of one or more compartments; and (2) radiation damage to a particular cell depends on radiation damage being sustained either by a single compartment or by a combination of compartments. P.V.E.

N64-15210* California U., Berkeley Lawrence Radiation Lab.
SEDIMENTATION PROPERTIES OF NUCLEATED AND NONNUCLEATED CELLS IN NORMAL RAT BONE MARROW

Howard C. Mel *In its* Semiann. Rept.—Biol. and Med., Spring, 1963 p 69–74 refs Submitted for Publication (See N64-15201 07-01) OTS: $2.75

The process of differential sedimentation leading to separation of the nonnucleated and nucleated cells in bone marrow is discussed. This sedimentation process, which takes place in a continuously flowing system under only 1 gravity, is believed to depend strongly on cell size. It results in apparently anomalous sedimentation behavior of the nucleated and nonnucleated cellular components—namely, the more rapid sedimentation of the nucleated cells. P.V.E.

N64-15211* California U., Berkeley Lawrence Radiation Lab.
DIFFUSION-GRAVITY CONTROLLED ENZYME-SUBSTRATE REACTION

Howard C. Mel *In its* Semiann. Rept.—Biol. and Med., Spring, 1963 p 75–82 refs (See N64-15201 07-01) OTS: $2.75 (Supported by AEC)

A description is presented of the phenomenon of induced microconvectional instability (or "droplet sedimentation") in a continuous flowing system and of experiments in which it was used to control a steady-state model enzyme–substrate reaction. It was found that "competitive diffusion" and normal gravity interact to transport lysozyme rapidly into its separated substrate in an initially stably layered flow-system. A continuous steady-state enzyme reaction is thus controlled by gravity and by the diffusion coefficients of inert components. It is concluded that should this transport mechanism play a role in any biological function, then in "weightlessness" the function would be altered or would cease to operate. P.V.E.

N64-15212* California U., Berkeley Lawrence Radiation Lab.
CONVECTION IN LOW GRAVITATIONAL FIELDS
Milton J. Polissar *In its* Semiann. Rept.–Biol. and Med., Spring, 1963 p 83–98 (See N64-15201 07-01) OTS: $2.75
(Supported by NASA)

A description is presented of experiments carried out in an attempt to answer the following types of questions: (1) Given a cylinder containing a heavy solution in its lower half and a light solution in its upperhalf, what is the nature of the motion of the liquid when the cylinder is rotated through an angle of 90° about an axis perpendicular to its own axis, and how is the motion affected by a decrease in the gravitational force. (2) Given two reservoirs containing solutions of densities ρ_1 and ρ_2, with $\rho_1 > \rho_2$, and with the denser solution situated above the lighter solution, what is the mechanism of exchange of solutions between the two reservoirs if they are connected by a tube of length H and rudius R; how are the qualitative and the quantitative characteristics of the counterflow exchange affected by the values of H, R, and by the viscosity, η, of the fluid; and what are the qualitative effects on the volume exchange when the gravitational acceleration g (considered as a variable) is progressively decreased to a very small fraction of the value of g at the surface of the earth. P.V.E.

N64-15213* California U., Berkeley Lawrence Radiation Lab.
PATTERNS OF HIGH- AND LOW-DENSITY LIPOPROTEIN DISTRIBUTIONS IN MAN
Alex V. Nichols, Robert K. Tandy, and Oliver F. deLalla *In its* Semiann. Rept.—Biol. and Med., Spring, 1963 p 99–117 refs (See N64-15201 07-01) OTS: $2.75

High- and low-density ultracentrifugal lipoprotein data for a healthy human population are evaluated in terms of their distribution properties. Appreciable and significant differences in the relative constellations of mean serum-lipoprotein concentrations appear at the extremes of the distributions determined for specific lipoprotein species. The implications of these distribution data for health and disease are discussed. Author

N64-15214* California U., Berkeley Lawrence Radiation Lab.
A CYTOPHOTOMETRIC METHOD FOR STUDY OF THE ERYTHROID DEVELOPMENT SEQUENCE IN MAMMALS
Lawrence R. Adams and Charles A. Sandhaus *In its* Semiann. Rept.–Biol. and Med., Spring, 1963 p 118–125 refs (See N64-15201 07-01) OTS: $2.75

A system is presented that solves the problem of determining the total cellular quantities of absorbing materials in cells where such cell materials are irregularly distributed. The system is sufficiently sensitive to measure with reasonable accuracy a total cellular hemoglobin amounting to less than 10% of the amount in a mature erythrocyte. The photographic method described can record 100 usable cell images on an 8-inch strip of 35-mm film. The film is exposed and developed in such a manner that the light transmission through the photographic cell image is a linear function of the amount of absorbing material in each subarea of the cell being analyzed. P.V.E.

N64-15215* California U., Berkeley Lawrence Radiation Lab.
SENSITIVITY OF THE POSITRON SCINTILLATION CAMERA FOR DETECTING SIMULATED BRAIN TUMORS
Alexander Gottschalk and Hal O. Anger *In its* Semiann. Rept.–Biol. and Med., Spring, 1963 p 126–129 refs (See N64-15201 07-01) OTS: $2.75

The results of a phantom study with the positron scintillation camera are compared with the findings of a similar study with the conventional positron scanner using As^{74}. The results indicated that the positron scintillation camera is a more sensitive instrument for the detection of brain lesions than the conventional positron scanner since it detects lesions one-third to one-fifth as large in volume for each ratio of tumor-to-brain concentration studied. P.V.E.

N64-15216* California U., Berkeley Lawrence Radiation Lab.
USE OF A WHOLE-BODY COUNTER IN TURNOVER STUDIES WITH Ca^{47}
Thornton Sargent, John A. Linfoot, Henry Stuffer, and John H. Lawrence *In its* Semiann. Rept.–Biol. and Med., Spring, 1963 p 130–138 refs (See N64-15201) OTS: $2.75

A whole-body counter has been used to study Ca^{47} turnover in normal subjects, in patients with metastatic breast cancer, and in patients with acromegaly. Patients with osseous metastases of breast cancer have greatly increased turnover rate. Patients with acromegaly have increased retention of calcium, presumably in bone, and the extent of increased retention seems to correlate with the severity of the disease. Author

N64-15217* California U., Berkeley Lawrence Radiation Lab.
HEAVY-PARTICLE IONIZATION (H, He, Li, B, C, N, O, F, Ne, Ar) AND THE PROLIFERATIVE CAPACITY OF NEOPLASTIC CELLS *IN VIVO*
Karen Sillesen, John H. Lawrence, and John T. Lyman *In its* Semiann. Rept.–Biol. and Med., Spring, 1963 p 139–151 refs (See N64-15201 07-01) OTS: $2.75

Using two neoplasms in mice, the relative biologic effect (RBE) of several heavy particles with various energies, nuclear mass, and charge was studied in an attempt to aid in further understanding the mechanism of action of densely ionizing radiation. The following conclusions were drawn from the investigation: (1) The Bragg-peak ionization produced by 910-Mev alpha particles has a greater RBE than the plateau region of ionization, as measured by the proliferative capacity of neoplastic cells grown in the living animal after irradiation; this is an advantage in the use of these particles in therapy. (2) Disappearance of the oxygen effect requires a very high linear energy transfer (LET). P.V.E.

N64-15242 California U., Berkeley Lawrence Radiation Lab.
CHEMICAL ELEMENTS IN THE SERUM OF MAN IN HEALTH AND DIABETES MELLITUS. X-RAY EMISSION SPECTROGRAPHIC DETERMINATIONS
Lynn Richard Anspaugh (Ph.D. Thesis) Sep. 1963 81 p refs
(Contract W-7405-eng-48)
(UCRL-10873) OTS: $2.00

The use of the X-ray spectrograph in determining the levels of chemical elements in serum is discussed. Particular attention is devoted to the development of proper background correction formulae and tests of experimental reliability. These spectrographic and analytical techniques were used to determine the levels of 29 elements in a pooled serum-powder sample from 125 healthy males and individual serum-powder samples from 33 diabetic subjects. Limits of sensitivity varied from 0.01 to 24 μg/cc whole serum, depending on the particular element studied. Diabetics were found to have significantly higher levels of phosphorus and potassium ($p<0.01$). A highly significant correlation between serum copper levels and the age at onset of diabetes was found. There was not an inverse correlation between serum copper and serum iron levels, as would be expected if this effect were due to fortuitous infections in the individuals with high serum copper. The possible significance of these findings in the pathogenesis of diabetes is discussed. Author

N64-15293 Joint Publications Research Service, Washington, D.C.

COMPARATIVE EVALUATION OF THE EFFECTIVENESS OF BACTERIA COLLECTORS IN DETERMINING BACTERIAL AEROSOL CONCENTRATION

V. S. Kiktenko et al 18 Feb. 1964 9 p refs Transl. into ENGLISH of an article from Gigiyena i Sanit. (Moscow), no. 10, 1963 p 45–48

(JPRS-23283; OTS-64-21590) OTS: $0.50

An objective method was established, based on the utilization of a flow ultramicroscope, for determining the partial concentration of bacterial aerosols. Connected to the flow ultramicroscope is a highly sensitive photoelectric installation and an electromechanical counter that permits automatic computation of particles of the aerosol passing through the cuvette of the flow ultramicroscope. Using this method of determining the concentration of a bacterial aerosol, a comparative evaluation of the collecting capacity of various instruments (bacterial collectors of various types as well as with cotton filters saturated with a mixture of 3% gelatin and vaseline oil) was carried out. Based on the results of the evaluations, it was found that with a bacteria collector having a cotton–wool filter saturated with a 3% solution of gelatin and vaseline oil, it is possible to determine 89% of all the microorganisms found in the unit of volume of air in the cuvette chamber. The collecting capacity of instruments without filters varied from 0.3% to 14%. P.V.E.

N64-15305* California U., Berkeley Space Sciences Lab.

EVIDENCE FOR LIFE ON MARS

D. G. Rea Repr. from Nature (London), v. 200, no. 4902 12 Oct. 1963 p 114–116 refs

(NASA Grant NsG-101-61)

The evidence for and against the existence of life on Mars is briefly discussed. In particular, the various arguments for the existence of Martian life discussed are: (1) the various colors, including green, exhibited by the dark areas; (2) the seasonal changes in the visual albedo and polarization of the dark areas; (3) the ability of the dark areas to regenerate after an extensive "dust storm;" and (4) the presence of 2,700 to 3,000 cm^{-1} "absorption" bands, attributed to organic molecules. As a result of the discussion, it is suggested that the life interpretation is very tenuous and that inorganic interpretations should be given greater credence. P.V.E.

N64-15307* Maryland U., College Park

INJURY AND RECOVERY OF PHOTOSYNTHESIS IN CELLS OF SUCCESSIVE DEVELOPMENTAL STAGES: TEMPERATURE EFFECTS

Constantine Sorokin Repr. from Microalgae and Photosynthetic Bacteria, 1963 p 99–109 refs

(NASA Grant NsG-70-60)

Temperature dependence of the fluctuations in photosynthetic activity in the course of a photosynthetic experiment was studied on the synchronized 4-hour cells of the high-temperature strain 7-11-05 of *C. pyrenoidosa*. Observations at 25° C revealed the same fundamental pattern in changes in photosynthetic activity with time as that previously described at 39° C, and the same basic trends: the upward trend thought to be a reflection of the preponderance of the anabolic processes and the downward trend indicating a prevalence of the catabolic processes. Light characteristics of these trends were at 25° C qualitatively similar to those at 39° though due to temperature effects a response to the increase in light intensity was in absolute figures smaller at 25° than at 39° C. Temperature dependence was clearly indicated for the upward trend. The effect of temperature on the downward trend depended on the light intensity at which it was studied. Author

N64-15327 Joint Publications Research Service, Washington, D.C.

PROBLEMS IN PROTECTING HUMAN BEINGS FROM RADIATION IN SPACE

Ye. S. Matusevich and S. G. Tsypin 19 Feb. 1964 13 p refs Transl. into ENGLISH of an article from Atomnaya Energ. (Moscow), v. 15, no. 6, Dec. 1963 p 499–504

(JPRS-23306; OTS-64-21606) OTS: $0.50

The sources of ionizing radiation in outer space and their biological effect are examined. The weight of the shield of the spacecraft is estimated. It is shown that the weight of the shield must be several tons when the craft passes through radiation belts and during solar flares. Galactic cosmic radiation protection during prolonged interplanetary flights will undoubtedly be very substantial and weigh about 10 tons. Author

N64-15334 Joint Publications Research Service, Washington, D.C.

STUDIES IN GAS METABOLISM OF COLD-BLOODED ANIMALS AND MIGRATIONS AND RADIOACTIVITY OF CERTAIN MARINE ANIMALS

18 Feb. 1964 56 p refs Transl. into ENGLISH of 3 articles from Zool. Zh. (Moscow), no. 11, Nov. 1963 p 1593–1612 and 1722–1724

(JPRS-23285; OTS-64-21592) OTS: $1.50

CONTENTS:

1. DIURNAL COURSE OF THE INTENSITY OF GAS METABOLISM IN COLD-BLOODED ANIMALS G. G. Vinberg and Yu. S. Belyatskaya-Potayenko p 2–20 refs

2. DOWNSTREAM DESCENT AND DIURNAL VERTICAL MIGRATIONS OF BENTHIC INVERTEBRATES IN THE AMUR O. A. Klyuchareva p 21–49 refs

3. RADIOACTIVITY OF SOME MARINE ANIMALS OF FEODOSIYSKIY BAY O. G. Mironov p 50–54 refs

N64-15335 Joint Publications Research Service, Washington, D.C.

TEMPERATURE REACTION OF THE SKIN DURING IRRADIATION WITH MICROWAVES OF LOW INTENSITY

Yu. A. Osipov and T. V. Kalyada 18 Feb. 1964 12 p refs Transl. into ENGLISH of an article from Gigiena i Sanit. (Moscow), no. 10, 1963 p 73–78

(JPRS-23287; OTS-64-21594) OTS: $0.50

The temperature reaction of the skin of open surface of the human body was investigated during irradiation with three-centimeter and ten-centimeter waves having continuous and impulse-modulated vibrations, with the full flow of the capacity being from 10 to 20 $\mu W/cm^2$, i.e., lower than thermogeneous. Results are: (1) Irradiation with microwaves, the intensity of which is considerably lower than that causing overall thermal heating, caused a positive reaction of the skin of the exposed surfaces of the body, both in the irradiated portion and in other parts of the body. (2) The positive reaction of the skin was weak in persons not previously subjected to irradiation. The degree of reaction increased in persons working under conditions of microwave irradiation, in direct relation to the length of employment. (3) The increase in the skin temperature cannot be explained, as the direct heating of the irradiated surface by the microwave energy transmitted to the body and absorbed by the skin is of insignificant quantities. The increase is probably of a reflex nature. (4) The data obtained contradict the supposition concerning the nonthermal action of small-intensity irradiation. I.v.L

N64-15336 Joint Publications Research Service, Washington, D.C.

SOVIET DIAGNOSTIC RADIOLOGY, A SURVEY OF THE PUBLISHED LITERATURE, 1959-1963

Victor Dukoff 20 Feb. 1964 70 p refs

(JPRS-23317; OTS-64-21611) OTS: $2.00

This survey covers the following topics: (1) methods of clinical and experimental radiodiagnosis as applied to various organs and tissues—tomography, angiography, isotopic radiography, pneumography, contrast methods, pneumoperitoneum, pneumomediastinography, and cholangiography, electrokymography, cineroentgenography, teleroentgenography, and radiodiagnostic procedures; (2) prophylactic fluorography; (3) training of roentgenologists and organizational problems; (4) congresses on roentgenology and radiology; and (5) an outline of plans for the years 1962 to 1970. R.T.K.

N64-15341 California U., Los Angeles Lab. of Nuclear Medicine and Radiation Biology

SEMIANNUAL PROGRESS REPORT FOR THE PERIOD ENDING DECEMBER 31, 1963

[1963] 109 p refs

(Contract AT-(04-1)-GEN-12)

(UCLA 520)

Short summaries are presented of work carried out in radiobiology, biochemistry, pharmacology and toxicology, nuclear medicine, biophysics, and environmental radiation. P.V.E.

N64-15345* Naval School of Aviation Medicine, Pensacola, Fla.

EXCRETION OF 17-HYDROXYCORTICOSTEROIDS, CATECHOLAMINES, AND UROPEPSIN IN THE URINE OF NORMAL PERSONS AND DEAF SUBJECTS WITH BILATERAL VESTIBULAR DEFECTS FOLLOWING ACROBATIC FLIGHT STRESS

James K. Colehour and Ashton Graybiel 10 May 1963 14 p refs Joint Report with NASA

(NASA Order R-47)

(NASA CR-55623; BuMed. 1) OTS: $1.60 ph, $0.80 mf

Six men with labyrinthine defects and 11 normal subjects were exposed to flight stress in an AD5 aircraft in an effort to determine the role of the vestibular organs in the excretion of catechols and steroids. Chemical measurements revealed that a significant increase in excretion of these stress hormones occurred in response to flight stress in case of the normal but not of the L-D subjects, which must have been attributable to the presence and absence, respectively, of the sensory organs of the inner ear. No significant changes in release of uropepsin were observed for either group. It is concluded that the vestibular organs must be taken into account in evaluating the effects of actual and simulated flight stresses where the gravitational inertial force environment is a variable. Author

N64-15346* Naval School of Aviation Medicine, Pensacola, Fla.

EXPERIMENTS WITH *DROSOPHILA MELANOGASTER* IN MAGNETIC FIELDS

Perry Close and Dietrich E. Beischer 1 Aug. 1962 13 p refs Joint Report with NASA

(NASA Order R-39)

(NASA CR-55625; BuMed-7) OTS: $1.60 ph, $0.80 mf

No genetic effects of homogeneous magnetic fields were observed on *Drosophila* up to a field strength of 120,000 gauss and an exposure time of 1 hr; neither do such effects seem to exist in strong inhomogeneous fields with high gradients of field strength. In most of the experiments, the biological systems were exposed during the total development time from egg to imago. Synergetic effects on *Drosophila* of the magnetic field in combination with X-radiation, starvation, hyperoxia, and hypoxia have also not been observed. Author

N64-15350* Naval School of Aviation Medicine, Pensacola, Fla.

POSITIONAL ALCOHOL NYSTAGMUS IN RELATION TO LABYRINTHINE FUNCTION

Charles S. Harris, Frederick E. Guedry, and Ashton Graybiel 3 Dec. 1963 22 p refs Joint Report with NASA

(NASA Order R-47)

(NASA CR-55619; BuMed-76) OTS: $2.60 ph, $0.86 mf

Individuals without functional labyrinths did not exhibit nystagmus comparable in quality or magnitude to results obtained from a group of normal subjects. Several individuals suspected of having residual otolith function exhibited weak responses reminiscent of PAN, but the "responses" may have been attributable to artifacts. A relationship was found in normal subjects between nystagmus obtained by caloric stimulation and nystagmus obtained by positional alcohol testing. The relationship between nystagmic output and arousal was found to be essentially the same for positional alcohol nystagmus as for nystagmus obtained by other procedures. All labyrinthine-defective subjects tested for alcohol gaze nystagmus exhibited alcohol gaze nystagmus. Author

N64-15351* Naval School of Aviation Medicine, Pensacola, Fla.

ROTARY AUTOKINESIS AND DISPLACEMENT OF THE VISUAL HORIZONTAL ASSOCIATED WITH HEAD (BODY) POSITION

Earl F. Miller II and Ashton Graybiel 5 Mar. 1963 13 p refs Joint Report with NASA

(NASA Order R-47)

(NASA CR-55618; BuMed-77) OTS: $1.60 ph, $0.80 mf

The visual horizontal as judged by four normal subjects was recorded every 2 seconds during periods lasting up to 23 minutes. Each subject was tested in an upright, then in a recumbent (left side) position. In both positions the procedure was identical. It was found that a lack of visual cues did not appreciably influence the accurate and relatively stable localization of the horizontal in the upright position; however, in the recumbent position removal of these cues caused, after a brief lag period, a gradual spontaneous rotation of the phenomenal horizontal up to a maximum displacement typical for each subject. Superimposed upon these perceptual changes was the considerable fluctuant movement in horizontality, which was described as a form of autokinesis (rotary). Qualitatively, the time course of these perceptions was similar and highly reliable for all subjects. In a subsequent (recumbent) trial, two subjects observed the target for thirty minutes in the dark. The error perceived remained essentially at the same level for one subject, but decreased significantly for the other. Author

N64-15352* Naval School of Aviation Medicine, Pensacola, Fla.

A SIGNAL CONDITIONER AND ELECTRODE TECHNIQUE FOR NYSTAGMUS MEASUREMENTS

W. Carroll Hixson and Jorma I. Niven 6 Mar. 1963 18 p refs Joint Report with NASA

(NASA Order R-37)

(NASA CR-55167; BuMed-78) OTS: $1.60 ph, $0.80 mf

An instrument was developed utilizing commercially available transistor preamplifiers that allows the simultaneous registering of horizontal and vertical nystagmic eye motions as derived from corneo-retinal potentials. The unit is capable

of operating in the acceleration environment afforded by either stimulus device and can be calibrated and controlled from a remote operating station. A description is also provided of the surface electrode techniques utilized in conjunction with the instrument to obtain reliable nystagmus data. Author

N64-15363 Naval Air Development Center, Johnsville, Pa. Aviation Medical Acceleration Lab.

LACK OF PREDICTABILITY IN RATS TO EXHIBIT CHRONIC OXYGEN POISONING Interim Report

George H. Kydd, L. Kowalski, and R. Mc Gowan 30 Dec. 1963 12 p refs Presented at the Aerospace Med. Assn. Meeting, Apr. 1963, under the title "Specificity of Chronic Oxygen Toxicity"

(NADC-MA-6324; AD-428048)

Sprague–Dawley descended rats have been repeatedly exposed to oxygen at high pressure. Chronic oxygen toxicity was obtained in one group of animals while in two other groups no permanent paralysis was obtained. It is suggested that a third factor, perhaps environmental, may have a role in predisposing rats to the development of the chronic signs of oxygen toxicity. The relationship of chronic to acute signs is discussed. Author

N64-15374 Air Force Cambridge Research Labs., Bedford, Mass.

SEVERAL PROPERTIES OF A VOCAL SOUND PITCH OBSERVED FROM THE VIBRATIONS OF THE TRACHEAL OUTER WALL

Shizuo Hiki Bedford, Mass., AFCRL, [1963] 7 p refs Transl. into ENGLISH from Accoust. Soc., Japan, Meeting, 1961 by Emmanuel Coll.

(Contract AF 19(604)-8505)

(E-T-J-63-5; AD-428505)

Data are presented on properties of vocal-sound pitch variations observed from the vibrations of the tracheal outer wall as an aid to pitch determination from vocal-sound wave patterns coming from the mouth. Among the properties studied were: distribution of pitch periods, conscious gentle variation, incidental sudden variations, and fine variations.

R.T.K.

N64-15382 Joint Publications Research Service, Washington, D.C.

PHYSICO-CHEMICAL RESEARCH

17 Feb. 1964 47 p refs Transl. from RUSSIAN into ENGLISH of 3 articles

(JPRS-23254; OTS-64-21575) OTS: $1.25

CONTENTS:

1. NEW DRUGS FOR THE TREATMENT OF DISEASES OF THE CENTRAL NERVOUS SYSTEM S. S. Liberman and M. D. Mashkovskiy p 1–17 refs (See N64-15383 07-16)

2. PHARMACOLOGY OF THE SYMMETRICAL BIS-QUATERNARY DERIVATIVES OF 9-METHYL-3, 9-DIAZOBICYCLO-(3,3,1)-NONANE M. D. Mashkovskiy and B. A. Medvedev p 18–31 refs (See N64-15384 07-16)

3. THE CHOLINOLYTIC ACTIVITY AND PHYSICO-CHEMICAL PROPERTIES OF ALKYLAMINOETHYL BENZILATES S. G. Kuznetsov and S. N. Golikov p 32–44 refs (See N64-15385 07-16)

N64-15383 Joint Publications Research Service, Washington, D.C.

NEW DRUGS FOR THE TREATMENT OF THE CENTRAL NERVOUS SYSTEM

S. S. Liberman and M. D. Mashkovskiy *In its* Physico-Chem. 17 Feb. 1964 p 1–17 refs Transl. into ENGLISH from Med. Prom. SSSR (Moscow), v. 13, no. 3, 1959 p 6–13 (See N64-15382 07-16) OTS: $1.25

The following drugs and their uses are discussed: (1) diphenylmethane derivatives, used primarily as tranquilizers for treating various forms of psychoneuroses and neuroses(benadril, covatix, atarax, Benactizine, Frenquell, and Piridrol); (2) propanol derivatives, used as tranquilizers, with no effect on the vegetative branch of the nervous system, yet having a significant antispasmodic effect in the case of spasms induced by strychnine and Korasole (Myanesin, Meprotan, Prenderol, Neuroton, and Robaxin); (3) derivatives of unsaturated tertiary alcohols, tranquilizing sleep-inducing drugs that possess antispasmotic properties (Sonbinol, N-Oblivon, Ethchlorvynol, Valamin, Dolcental, and Repocal); (4) Diphenazin, a tranquilizer that causes an active neuroplegic effect on the central nervous system; and (5) Nostyn (Ethylurea), a mild tranquilizer that normalizes the behavior of patients and causes general calming. P.V.E.

N64-15384 Joint Publications Research Service, Washington, D.C.

PHARMACOLOGY OF THE SYMMETRICAL BIS-QUATERNARY DERIVATIVES OF 9-METHYL-3, 9-DIAZABICYCLO-(3, 3, 1)-NONANE

M.D. Mashkovskiy and B. A. Medvedev *In its* Physico-Chem. Res. 17 Feb. 1964 p 18–31 refs Transl. into ENGLISH from Farmakol. i Toksikol. (Moscow), v. 23, no. 6, 1960 p 493–499 (See N64-15382 07-16) OTS: $1.25

Symmetrical bis-quaternary derivatives of 9-methyl-3,9-diazabicyclo-(3,3,1)-nonane (diiodomethylates of 1,6-bis-[9-methyl-3,9-diazabicyclo-(3,3,1,)-nonano-3]-hexane, 1,5-bis-[9-methyl-3,9-diazabicyclo-(3,3,1,)-nonano-3]-pentane, and 1,4-bis- [9-methyl-3,9-diazabicyclo-(3,3,1,)-nonane-3] -butane) were investigated and found to produce a strong blocking effect on the neuromuscular conductivity. The most effective curariform preparation was diidomethylate of 1,4-bis-[9-methyl-3,9-diazabicyclo-(3,3,1,)-nonano-3]-butane. The blocking effect on the behavior of nervous excitation in vegetative ganglia was less pronounced for the investigated substances. P.V.E.

N64-15385 Joint Publications Research Service, Washington, D.C.

THE CHOLINOLYTIC ACTIVITY AND PHYSICO-CHEMICAL PROPERTIES OF ALKYLAMINOETHYL BENZILATES

S. G. Kuznetsov and S. N. Golikov *In its* Physico-Chem. Res. 17 Feb. 1964 p 32–44 refs Transl. into ENGLISH from Farmakol. i Toksikol. (Moscow), v. 24, no. 3, 1963 p 275–279 (See N64-15382 07-16) OTS: $1.25

The m-cholinolytic activity, basicity, and lipoidophilic properties of a series of alkylaminoethyl esters of benzilic acid were investigated along with certain dialkylamino-ethyl esters of the same acid. As a result of a comparison of cholinoytic activity, chemical structure, and indicated physicochemical properties of the compounds, it is shown that structural characteristics of their ammonium group effect their cholinolytic activity. It is suggested that filling of the space around the nitrogen atom in cholinolytic substances plays a significant role in their activity. P.V.E.

N64-15397 Joint Publications Research Service, Washington, D.C.

HYGIENIC PROBLEMS IN THE RADIOACTIVE CONTAMINATION OF OUTER SPACE

18 Feb. 1964 8 p Transl. into ENGLISH of an article from Gigiyena i Sanit. (Moscow), no. 10, 1963 p 3–7

(JPRS-23284; OTS-64-21591) OTS: $0.50

Of particular interest to the hygienist are the radionuclides of strontium 90 and barium 140, and the speed with which these elements enter human and animal bodies through plants. Different radionuclides are absorbed differently into the stomach and intestinal tracts. Strontium 90, iodine 131, and cesium 137 are absorbed easily; radioactive isotopes of rare-earth elements, actinidia, and precious metals are absorbed in insignificant amounts. Strontium 90 is considered one of the most dangerous radionuclides, since it accumulates in the bone and has a half-life of 29 years. It is also found that ionizing radiation from fallout causes changes in the desoxyribonucleic acids of sex cells, thus affecting hereditary traits. Since there is no threshold mutational dose, any small dose of ionizing radiation can lead to the formation of mutations. The report includes data on the worldwide distribution of strontium 90 in soil and milk and on those micron-size particles ("hot" particles) that are, nonetheless, large enough to contain radioactive material (10^{-11} to 10^{-8} curie per particle). E.K.R.

N64-15398 Argonne Cancer Research Hospital, Chicago, Ill.
SEMIANNUAL REPORT TO THE ATOMIC ENERGY COMMISSION
Leon O. Jacobson and Margot Doyle, eds. Sep. 1963 149 p refs
(Contract AT(11-1)-69)
(ACRH-20) OTS: $2.50

CONTENTS:

1. LEUKEMIA AMONG CHILDREN IN A SUBURBAN COMMUNITY C. W. Heath (Tufts Hematology Lab.) and R. J. Hasterlik p 1–24 refs

2. A NUCLEAR NEEDLE FOR USE IN NEUROSURGERY S. Mullan (Chicago U.), P. V. Harper, Jr., E. Tani (Kyoto U. Med. School, Japan), G. Vailati (Chicago U.), and K. A. Lathrop p 25–35 refs

3. PERCUTANEOUS CORDOTOMY FOR PAIN S. Mullan, P. V. Harper, Jr., J. Hekmatpanah, H. Torres, and G. Dobben (Chicago U.) p 37–46 refs

4. RADIATION WITH HIGH ENERGY ELECTRONS USING PENCIL BEAM SCANNING J. W. J. Carpender, L. S. Skaggs, L. H. Lanzl, and M. L. Griem p 47–56 refs

5. VISUALIZATION OF THE LIVER BY SCANNING USING MO^{99} (MOLYBDATE) AS TRACER L. B. Sorensen and M. Archambault (Chicago U.) p 57–68 refs

6. METASTATIC CARCINOMA OF THE PARATHYROID AND PERSISTENT HYPOTHYROIDISM A. W. Lazar, R. L. Landau, and A. Kappas (Chicago U.) p 69–75 refs

7. FEVER PRODUCING ACTION OF STEROIDS R. H. Palmer and A. Kappas p 76–85 refs

8. EFFECTS OF STEROID SEX HORMONES ON IMMUNOLOGIC PHENOMENA A. Kappas, H. E. H. Jones, and I. M. Roitt (Courtauld Inst. of Biochem., Gt. Brit.) p 86–88 refs

9. THE EFFECT OF ERYTHROPOIETIN UPON UTILIZATION OF GLUCOSAMINE BY MARROW CELLS IN CULTURE P. P. Dukes, F. Takaku (Tokyo U.), and E. Goldwasser p 89–91 refs

10. EFFECT OF RADIATION ON INTERMEDIARY METABOLISM IN THE RAT J. H. Rust (Chicago U.), G. V. LeRoy, J. L. Spratt (Iowa State U.), L. J. Roth (Chicago U.), and G. B. Ho p 92–110 refs

11. STUDIES ON THE INTERACTION BETWEEN BOVINE SERUM ALBUMIN AND NATURAL AND SYNTHETIC POLYRIBONUCLEOTIDES. I. PREVENTION OF THE THERMAL COAGULATION OF BOVINE SERUM ALBUMIN BY NATURAL AND SYNTHETIC POLYRIBONUCLEOTIDES S. Yachnin (Chicago U.) p 111–116 refs

12. STUDIES ON THE INTERACTION BETWEEN BOVINE SERUM ALBUMIN AND NATURAL AND SYNTHETIC POLYRIBONUCLEOTIDES. II. STUDY OF THE INTERACTION BY MEANS OF DENSITY GRADIENT ULTRA CENTRIFUGATION S. Yachnin p 117–122 refs

13. SYNTHESIS OF POLYPSEUDOURIDYLIC ACID BY POLYNUCLEOTIDE PHOSPHORYLASE L. Sasse (Mass. Gen. Hosp.), M. Rabinowitz, and I. H. Goldberg p 123–131 refs

14. INHIBITION OF RNA POLYMERASE BY 6-AZAURIDINE TRIPHOSPHATE I. H. Goldberg and M. Rabinowitz (Chicago U.) p 132–135 refs

15. A SMALL ANIMAL SCANNING SYSTEM R. N. Beck and D. B. Charleston p 136–143 refs

16. STAFF PUBLICATIONS p 144

N64-15417 Joint Publications Research Service, Washington, D.C.
ON THE NATURE OF IMAGE (MENTAL REFLECTION IN THE LIGHT OF IDEAS OF CYBERNETICS)
V. S. Tyukhtin 25 Feb. 1964 137 p refs Transl. into ENGLISH of a book "O Prirode Obraza (Psikhicheskoye Otrazheniye v Svete Idei Kibernetiki)" Moscow, State Higher School Publ. House, 1963 p 3–123
(JPRS-23370; OTS-64-21636) OTS: $2.75

The following topics are discussed: (1) empirical signs of mental reflections and difficulties connected with explaining them; (2) two aspects of the analysis of the psyche; (3) similarity—the model and the signal; (4) the content and form of a signal; (5) physical similarity and the image; (6) conditions and mechanism of realization of the sensory image; (7) image and the conventional sign; (8) the nature of image and the problem of modeling mental functions; (9) the nature of image and certain methodological problems of psychology; and (10) the essence and general principles of reflection. R.T.K.

N64-15540* Naval School of Aviation Medicine, Pensacola, Fla.
FREQUENCY RESPONSE OF THE HUMAN SEMICIRCULAR CANALS. II. NYSTAGMUS PHASE SHIFT AS A MEASURE OF NONLINEARITIES
W. Carroll Hixson and Jorma I. Niven 26 Jul. 1962 20 p refs Joint Report
(NASA Order R-37)
(NASA CR-55624; Rept. 73) OTS: $1.60 ph, $0.80 mf

The existence of nonlinearities in the steady-state response of the oculovestibular system to sinusoidal angular acceleration is demonstrated by evaluation of corneo-retinal potential recordings obtained at rotation frequencies of 0.02 to 0.20 cps with peak acceleration levels ranging from 10 to 80 deg/sec^2. The experimental and theoretical considerations involved in using the nystagmus transition technique to study these nonlinearities are discussed, and an illustrative application of their quantification is presented. Author

N64-15550* Republic Aviation Corp., Farmingdale, N.Y. Life Sciences and Space Environment Lab.
STUDY OF THE NORMAL FECAL BACTERIAL FLORA OF MAN Quarterly Progress Report, 1 Oct.-31 Dec. 1963
Lorraine S. Gall et al 2 Jan. 1964 29 p
(NASA Contract NASw-738)
(NASA CR-55561; RAC-931-2) OTS: $2.60 ph, $1.07 mf

Twenty "type" cultures were established from the results of screen tests of more than 1,000 individual cultures. Most of these were strict anaerobes, particularly those isolated from the 10 individual healthy adult males in the study, and they maintained their particular anaerobic character and morphology even during the several transfers made to "establish" these "type" cultures. The continued isolation of fecal bacteria of 10 healthy young men resulted in more than three-fourths of these cultures fitting into some group of the 20 "type" cultures

so far "established." The bacteria carried by any one individual usually consisted of three or four separate "types" that often appeared in two or more separate fecal samples. R.L.K.

N64-15557 Tokyo U. (Japan) Inst. of Industrial Science
ENGINEERING APPROACHES TO FUNCTION OF FINGERS
Tadashi Yamashita and Masahiro Mori Nov. 1963 59 p refs (*Its* Serial 90, v. 13, no. 3)

This research is used to design and construct an artificial hand for engineering use. It has three fingers, each of which has three degrees of freedom; the resulting nine degrees of freedom (joints) are actuated independently by compressed air and automatically controlled by sequential control techniques, using feedback from the sensory organs at each joint. Control circuits and tables of sequential actions are shown. R.L.K.

N64-15570 Baylor U., Houston, Tex. Coll. of Medicine
ELECTROPHYSIOLOGIC CHARACTERISTICS AND INTERPRETATION OF SKIN POTENTIALS
Robert Edelberg AF School of Aerospace Med., Brooks AFB, Tex. Nov. 1963 14 p refs
(Contract AF 41(609)-1527)
(SAM-TDR-63-95; AD-429965)

The relation of skin potential and endosomatic galvanic skin response (GSR) to surface electrolytes reveals that the surface layer cannot explain the total potential difference across the skin. Furthermore, wide variations in surface potential induced by varying electrolyte concentrations have no effect on the GSR. Results are consistent with a base potential generated by two membranes in series—an outer one accessible to surface electrolytes, but not participating in the GSR, and an inner one inaccessible to surface media, but responsible for the positive component of the GSR. Microelectrode studies show there is a third structure in parallel, the sweat gland, which has different electrical characteristics and produces negative endosomatic waves. The two endosomatic GSR components manifest stimulus-response specificity and are apparently under independent neural control. Author

N64-15586 IIT Research Institute, Chicago, Ill.
RESEARCH ON THE CHEMICAL COMPOSITION AND DIGESTIBILITY OF ALGAL CELL WALL Technical Documentary Report [10 Oct. 1962-31 Aug. 1963]
Milton J. Becker and Alan M. Shefner Wright-Patterson AFB, Ohio, Biomedical Lab., Nov. 1963 35 p refs
(Contract AF 33(657)-10066)
(IITRI-L6002-4; AMRL-TDR-63-115; AD-429803) OTS: $1.00

Cell walls of the alga Chlorella pyrenoidosa 7-11-05 were isolated and purified. The carbohydrates present as monosaccharides in the purified cell walls and in chemical fractions of the cell walls were analyzed by paper chromatography and thin-layer chromatography (TLC). Rhamnose, glucose, and galactose were the predominant monosaccharides. Arabinose was not present in significant quantities in the cell walls or fractions thereof. Conditions for the large-scale heterotrophic growth of C. *pyrenoidosa* 7-11-05 were explored and found to be feasible. Studies on the growth and partial digestion of the algal cells by a fungus, *Asperquillus oryzae*, were found to be feasible. Such studies were oriented toward controlled feedings of the alga, the alga–fungus mixture, and the fungus to young rats. Author

N64-15590 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ATMOSPHERE OF THE SPACE SHIP
Yuriy Ivanov 25 Oct. 1962 6 p Transl. into ENGLISH from Sov. Latviya (Moscow), no. 194, 17 Aug. 1962
(FTD-TT-62-1545/1; AD-290833)

Comparisons are made of three possible methods of regulating the gaseous content of the atmosphere in the cabin of a spaceship; the control of cabin temperature is discussed. Particular emphasis is placed on an automatic system of controlling the gaseous composition of the air by employing sensitive elements that detect the deviation in the content of oxygen, carbon dioxide, and moisture, and a regulator that controls the rate of corresponding reactions in the regenerator. For temperature control, attention is directed toward a system of shutters on the spaceship that makes it possible to change the radiation capacity, increase the effectiveness of the heat regulation, and ensure high precision in holding a given temperature for the cabin. C.L.W.

N64-15592 Arizona U., Tucson Engineering Research Labs.
STUDY AND RESEARCH ON ELECTRONIC SIMULATION OF THE BIOLOGICAL CLOCK II
Andrew P. Sage, Jr., Keith E. Justice, and James L. Melsa Wright-Patterson AFB, Ohio, Electron. Technol. Lab. May 1963 75 p refs
(Contract AF 33(616)-7677)
(ASD-TDR-63-136; AD-428234) OTS: $2.00

The term "biological clock" has been given to the phenomenon displayed by organisms, both plants and animals, that pace their functions in a cyclic fashion that is related in some way to environmental stimuli. This report extends a previous report on the biological clock to include: (1) Design and construction of an experimental facility to compare specific data from the electronic model with animals subjected to the same environmental conditions simulated on the model; (2) Biological experimentation and statistical analysis of the biological results to test validity of the biological clock and suggest improvements for the mathematical and electronic model; (3) Cellular analysis of some functional aspects of the c(t) generation in order to initiate establishment of a one-to-one correspondence with the model of the biological clock; (4) Investigation of adaptive and learning system capabilities of the biological clock; and (5) Development of a better model for the biological clock and possible engineering system implications. Author

N64-15622 Joint Publications Research Service, Washington, D.C.
PSYCHOPATHOLOGY AND BIOCHEMISTRY OF EXPERIMENTAL PSYCHOSES PRODUCED BY ANTICHOLINERGIC HALLUCINOGENS
H. Bultasova et al 19 Feb. 1964 13 p Transl. into ENGLISH of an article from Ideggyogy. Szemle (Budapest), v. 13, no. 8, Aug. 1960 p 225–234
(JPRS-23296; OTS-64-21598) OTS: $0.50

Benactyzine was administered to 12 subjects in a dose of 40 to 75 mg and lead, in the majority of persons, to an experimental psychosis of Bonhoeffer's exogenic reaction type. When the psychotic changes were at their maximum, a striking drop in the excretion of 5-hydroxy-indoleacetic acid (5-HIAA) was observed in the majority of experimental subjects. The psychotogenic action is explained hypothetically as an intervention in the serotonin and acetylcholine metabolism. Author

N64-15672 European Atomic Energy Community, Brussels (Belgium)
STUDIES ON THE DISTRIBUTION OF TRACE ELEMENTS IN A MOLLUSK FROM A FRESHWATER ENVIRONMENT, BY ACTIVATION ANALYSIS

F. Girardi and Margaret Merlini Joint Nuclear Res. Center, Ispra Establishment (Italy). Biology and Nuclear Chemistry Services. 1963 28 p refs Presented at the Symp. on Radioact. Analysis and its Appl. to the Biol. Sci., Saclay (France), 26-28 Sep. 1963
(EUR-474.e) Available from Belgian American Bank and Trust Co., N.Y., account No. 121.86: 40 BF

A semiautomated system for the determination of trace elements in biological materials by means of activation analysis is described. The system is based on the chemical separation of elements in the irradiated specimens by chromatographic procedures; automatic gamma spectrometry, with the use of sample changers; and automatic treatment of the experimental data by computer techniques. Although the system has not yet been perfected, it appears that approximately 100 samples per month with 12 to 15 elements per sample can be determined. It is possible, therefore, to use this system for an accurate and more thorough investigation of well-chosen, biologically significant elements. The biological results obtained on *Unio*, a bivalve from Lake Maggiore, revealed the presence of elements never before determined in a mollusk from a freshwater environment. Author

N64-15676 Joint Publications Research Service, Washington, D.C.
TREATMENT OF RADIATION INJURY AND SICKNESS
24 Jan. 1964 38 p refs Transl. into ENGLISH of 5 articles from Med. Radiol. (Moscow), v. 8, no. 11, Nov. 1963 p 3-9, 30-33, 47-50, and 55-63
(JPRS-22879; OTS-64-21376) OTS: $1.00

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N64-15677 Joint Publications Research Service, Washington, D.C.
THE MAIN PRINCIPLES IN THE DISPENSARY CARE OF PERSONS WORKING WITH SOURCES OF IONIZING RADIATION AND OF SCIENTIFIC ANALYSIS OF THE RESULTS OF MEDICAL OBSERVATION OF THEM
A. K. Gus'kova *In its* Treat. of Radiation Injury and Sickness 24 Jan. 1964 p 1-9 (See N64-15676 07-16) OTS: $1.00

For the organization of dispensary observation of a radiological category, all the main concepts of general industrial hygiene and occupational pathology remain in force. Special radiometric laboratories should be provided in order to clarify the quantitative characteristics of radiation effect. An essential part in the organization of dispensary observation and subsequent scientific analysis is the documentation of medical examinations. The diagnosis of various cases of occupational radiation sickness should be based on a good knowledge of the standard indices for the symptoms being investigated. E.W.

N64-15678 Joint Publications Research Service, Washington, D.C.
TREATMENT OF RADIATION INJURIES OF THE SKIN AND MUCOUS MEMBRANES WITH CHLOROPHYLL-CAROTENE PASTE
L. M. Stukova, S. V. Strutsovskaya, V. A. Repina, and V. P. Luk'yanov *In its* Treat. of Radiation Injury and Sickness 24 Jan. 1964 p 10-14 refs (See N64-15676 07-16) OTS: $1.00

Application of the chlorophyll-carotene paste to the area of radiation lesions of the skin caused a rapid elimination of necrotic onlays from the wound surface, stimulated the development of granulation tissue and epithelization, and contributed to acceleration of the healing processes. The use of the chlorophyll-carotene paste in a mixture with novocain solution provided for elimination of painful sensation in the area of radiation lesion. E.W.

N64-15679 Joint Publications Research Service, Washington, D.C.
POSSIBILITY OF DETERMINING THE BODY'S REACTION TO IRRADIATION WITH SMALL DOSES OF IONIZING RADIATION BY MEANS OF OBSERVATION OF THE PHOSPHENE THRESHOLD OF THE RETINA
V. Glavaty, Z. Dienstbier, and M. Zhak *In its* Treat. of Radiation Injury and Sickness 24 Jan. 1964 p 15-20 refs (See N64-15676 07-16) OTS: $1.00

The results of the series of experiments performed showed that the phosphene threshold method is not suitable as a diagnostic technique for the determination of low radiation doses because only about 28% of the investigations indicated involvement of ionizing radiation in the increase of the phosphene index. E.W.

N64-15680 Joint Publications Research Service, Washington, D.C.
THE EFFECT OF PRELIMINARY IMMUNIZATION WITH LIVING VACCINES ON THE COURSE AND OUTCOME OF RADIATION SICKNESS IN RABBITS
A. M. Sudnov *In its* Treat. of Radiation Injury and Sickness 24 Jan. 1964 p 21-27 refs (See N64-15676 07-16) OTS: $1.00

Preliminary subcutaneous injection of STI anthrax vaccine is capable of reducing the mortality rate of animals from radiation sickness. The reduction in the mortality rate is attributed to the development of a vaccinal process in the body, which leads to an increase in its protective forces. Author

N64-15681 Joint Publications Research Service, Washington, D.C.
DISTRIBUTION OF P^{32} IN THE TISSUES OF RAT ORGANS AFTER THE EFFECT OF PENETRATING RADIATION AND THE ADMINISTRATION OF ACTH
P. I. Lomonos and A. Shamakhmudov *In its* Treat. of Radiation Injury and Sickness 24 Jan. 1964 p 28-35 refs (See N64-15676 07-16) OTS: $1.00

After rats are injected with two units of ACTH per 100 grams of body weight, there is a marked increase in the tissue permeability of the suprarenal glands, and pronounced changes

occur in the peripheral blood composition. The degree of change observed is related to the time that has elapsed after injection of the hormone. On the third day of radiation sickness following whole-body irradiation with an X-ray dose of 800 r, the permeability of all the investigated organs increases markedly, whereas on the first and sixth days of radiation sickness, it is not much different from the control. For the first few hours after the injection of ACTH into irradiated animals on the third day of radiation sickness, the tissue permeability is reduced; after nine hours, the previous level is regained. After the injection of ACTH into animals on the first and sixth days of radiation sickness, the tissue permeability of the organs remains unchanged, with the exception of the tissue of the suprarenal glands; in the latter it is considerably increased six and nine hours after injection. Author

N64-15716 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

PREPARATION AND PROPERTIES OF A FREE SOIL ENZYME

Michael H. Briggs and Leah Segal (Victoria U., Wellington) Repr. from Life Sci. no. 1, 1963 p 69–72

(Supported by Victoria U. Research Committee)

An attempt was made to extract urease from soil, as a free enzyme, by a mild treatment that would not disrupt cells. Examinations indicate that the preparation obtained from the soil was a mixture of proteins possessing urease activity. The properties of this soil urease were, however, significantly different from those of ureases from other sources. E.W.

N64-15726 Milan U. (Italy) Centro di Cibernetica e di attivita Linguistiche

TOWARDS THE MECHANIZATION OF MENTAL ACTIVITIES

Silvio Ceccato et al [30 Jul. 1963] 78 p refs

(Contract AF 61(052)-362)

(RADC-TDR-63-528; AD-427084)

Research on the construction of a machine that observes and describes the events of its surroundings and its internal events ("Talking Automaton") is discussed. The report contains studies concerning: (1) the conceptual difficulties that a program of this type gives rise to; and (2) the block diagram of the machine and the scheme of the optical explorer with which the machine is equipped. Author

N64-15730 Joint Publications Research Service, Washington, D.C.

THE BIOSTRATIGRAPHIC SEPARATION OF BOTTOM SEDIMENTS AT STATION NO. 3802 IN THE EQUATORIAL PACIFIC

V. V. Mukhina 26 Feb. 1964 13 p refs Transl. into ENGLISH of an article from Okeanologiya (Moscow), v. 3, no. 5, 1963 p 861–869

(JPRS-23403; OTS-64-21657) OTS: $0.50

The station was located at latitude 3° 17'00" S. and longitude 172° 52'4" W. at a depth of 5329 m. The four biostratigraphic horizons were distinguished, according to the data from diatom analysis, species composition, and diatom population, as I from 0 to 25 cm from the top of the core, II from 25 to 135 cm, III from 135 to 205 cm, and IV from 205 to 266 cm. The deposits of horizon I correspond to the Holocene epoch, II and IV to the glacial periods, and III to the interglacial period. The data indicate that: (1) Diatoms in the surface waters of the equatorial Pacific became more abundant when the climate became colder rather than warmer. This was evidenced by the fact that the maximum number of large *Coscinodiscus nodulifer* was found in horizons II and IV. Consequently, conditions were created in the glacial epochs that favored the mass development of diatoms. (2) The climatic changes during sediment formation in the equatorial Pacific were not sharp, judging by the succession in species composition. Tropical species survived throughout the entire period of time reflected in the cores, but were most abundant in horizon I. I.v.L.

N64-15741 School of Aerospace Medicine, Brooks AFB, Tex.

CELLULAR OXYGEN CONSUMPTION AT LOW OXYGEN TENSIONS

Robert J. Reyes and J. Ryan Neville Nov. 1963 11 p refs

(SAM-TDR-63-68; AD-430363)

A baseline study has been made of various factors—including pH, cell concentration, temperature, and metabolic state—which might affect the critical oxygen tension (C.O.T.) of *Saccharomyces cerevisiae*. The metabolic state and temperature are found to have a significant effect on the C.O.T. The C.O.T. in the starved condition is independent of temperature, but the exogenous state exhibits an increase in C.O.T. with an increase in temperature. A comparison of the C.O.T. value at 25° C gave approximately 4 mm $HgPo_2$., in the exogenous state and less than 1 mm $HgPo_2$ in the starved state. These results, in general, confirm earlier studies. No effect of the C.O.T. by pH or cell concentration changes could be found. The C.O.T. of cytochrome-deficient *Neurospora crassa* mutants has been compared with that of normal strain, and no difference was observed. The polarographic methodology as applied to cellular oxygen consumption is described, and the practical significance that the C.O.T. measurement may have in study of cellular processes is discussed. Author

N64-15742 School of Aerospace Medicine, Brooks AFB, Tex.

IDENTIFICATION AND SIGNIFICANCE OF PAROTID FLUID CORTICOSTEROIDS

Fred H. Katz and Ira L. Shannon Oct. 1963 12 p refs

(SAM-TDR-63-86; AD-430367)

Parotid fluid was previously shown to possess free 17-hydroxycorticosteriod (17-OH-CS) levels that paralleled those in serum and reached a maximum two hours after corticotropin or cortisol administration to normal men. The present study demonstrated that intravenously administered cortisol appeared rapidly in the parotid fluid, and that parotid fluid 17-OH-CS levels would serve as reliable indicators of adrenal function. This was borne out by studies in a patient with Cushing's syndrome as well as in those showning adrenal hyporesponsiveness. These data are compatible with the hypotesis that only nonprotein-bound free 17-OH-CS reaches the parotid fluid. Conjugated 17-OH-CS was not found in appreciable quantity in parotid fluid. Chemical and radioisotopic technics indicated cortisol and cortisone to be the major human parotid fluid 17-OH-CS. Parotid tissue from the dog converted cortisol to cortisone. Radioactive aldosterone, estrogen, and androgen appeared in parotid fluid after intravenous injection. Author

N64-15743 School of Aerospace Medicine, Brooks AFB, Tex.

CORRELATION OF DISSOLVED NITROGEN IN WHOLE BLOOD WITH SELECTED WHOLE BLOOD CONTITUENTS

Omar V. Greene, Jr. Dec. 1963 10 p refs

(SAM-TDR-63-92; AD-430064)

The relationship of several whole blood constituents to the quantity of nitrogen in solution in the blood was studied by correlating the measured quantities of each with the amount of nitrogen present. The constituents and their mean values were as follows: whole blood lipids—589.62 mg%; plasma

lipids—598.45 mg%; total blood water—77.33%; hematocrit—46.12%. The mean value for nitrogen in solution was 0.01273 ml per milliliter of whole blood (Bunsen solubility coefficient). With the exception of hematocrit versus nitrogen, all correlation coefficients were found to be negative. None of the correlations were found to be significant. Author

N64-15744 School of Aerospace Medicine, Brooks AFB, Tex.
STUDIES IN DECOMPRESSION SICKNESS: CARDIORESPIRATORY RESPONSES OF ANESTHETIZED DOGS TO COMPRESSION THERAPY FOLLOWING EXPERIMENTAL DECOMPRESSION SICKNESS
Robert J. Mc Iver and Sidney D. Leverett, Jr. Dec. 1963 13 p refs
(SAM-TDR-63-94; AD-430123)

Decompression sickness was studied by use of a special technique for the production and recognition of the disorder in laboratory animals. Objective evidence is presented for substantiating the use of compression therapy in the treatment of both caisson and altitude types of decompression sickness. There is suggestive evidence that even very small overpressures may be of benefit in treating or transporting some cases of severe altitude decompression sickness. The importance of rapid recognition and treatment is emphasized, as well as careful scrutiny of all patients who appear to be "hyperventilating" after decompression, especially those patients with other signs or symptoms of decompression sickness. Author

N64-15745 Minnesota U., Minneapolis
THORACIC CAGE IMPEDANCE MEASUREMENT: CANCELLATION OF RESPIRATION EFFECTS ON TRANSTHORACIC IMPEDANCE
Edwin Kinnen and William Kubicek Brooks AFB, Tex., School of Aerospace Med. Dec. 1963 9 p refs
(Contract AF 41(657)-403)
(SAM-TDR-63-99; AD-429938)

Monitoring transthoracic electrical impedance related to cardiac activity has been hampered by changes in the measured impedance due to respiration. It is necessary to nullify respiration effects if a relatively undistorted cardiac activity waveform is to be recorded continuously during respiration. Both direct filtering and subtraction of the respiration signal from the composite respiration–cardiac waveform have been considered. Methods used to obtain a respiration signal for subtraction purposes were based on (1) a chest circumference measurement obtained with a bellows and pressure transducer, (2) the detection of an impedance change due solely to respiration, and (3) the utilization of the phase-angle signal associated with the transthoracic impedance. Promising results were obtained when the phase-angle signal was combined with the composite respiration–cardiac waveform. The effect of respiration impedance change on the resulting waveform was less than 50% of the cardiac activity signal under resting–breathing conditions. Author

N64-15746 Jefferson Medical Coll., Philadelphia, Pa.
THYROIDAL INFLUENCE ON ALTITUDE TOLERANCE
Domenic A. De Bias and Wang Yen Brooks AFB, Tex., School of Aerospace Med., Dec. 1963 7 p refs
(Contract AF 41(657)-253)
(SAM-TDR-63-101; AD-429507)

This investigation is aimed at obtaining support for the concept that lesser amounts of cortisol are effective in prolonging the survival time of thyroidectomized rats exposed to altitude because of a decreased catabolism of the steroid in hypothyroid animals. The data indicate that hyperthyroid animals are more susceptible to altitude exposure than are normal animals; a greater amount of cortisol is required to protect such animals than is required to protect altitude-exposed adrenalectomized animals that have also been thyroidectomized. Increased thyroid function in altitude-exposed animals is indicated by measurements on the following parameters, which were increased: thyroidal uptake of I^{131}, release of thyroidal I^{131}, erythrocyte uptake of I^{131}-labeled triiodothyronine. Author

N64-15802 Victoria U., Wellington (N. Zealand)
THE DISTRIBUTION OF AVIDIN
Peter D. Jones and Michael H. Briggs Repr. from Life Sci., no. 11, 1962 p 621–623 refs

Results are given of experiments conducted to determine the avidin content of egg whites. Avidin proteins are present in all eggs with the possible exception of the herring gull eggs. The results are expressed in avidin units per gram. C.L.W.

N64-15803 Victoria U., Wellington (N. Zealand)
FORMS OF SOIL BIOTIN
Peter D. Jones, Venise Graham, Leah Segal, W. Jeavons Baillie, and Michael H. Briggs Repr. from Life Sci., no. 11, 1962 p 645–648 refs

Data are presented on the presence of several forms of biotin in different soils and of their distribution with depth and various soil properties, such as soil pH. R.T.K.

N64-15828 Joint Publications Research Service, Washington, D.C.
RESTORATIVE PROCESSES IN THE DUODENAL MUCOSA FOLLOWING RADIATION INJURY
I. A. Chalisov and L. B. Berlin 13 Dec. 1963 7 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 151, no. 6, 1963 p 1450–1452
(JPRS-22276; OTS-64-21014) OTS: $0.50

The changes in the duodenal mucosa of albino rats were investigated at intervals ranging from zero hours to 15 days following general single irradiation from a cobalt-60 source, in a dosage of 900 r for 3 hr. The presence and extent of radiation injury were determined by hematological examination. In a special series of experiments to determine the survival rate, 50% of the rats died within 11 to 14 days. The study indicated that even with severe radiation injuries the restorative processes may take place quite successfully on the tissual and organic levels. C.L.W.

N64-15829 Joint Publications Research Service, Washington, D.C.
PRESENT STATUS OF THE PROBLEM OF CANCER CHEMOTHERAPY
Ye. I. Khomchenovskiy and K. I. Karpavichus 28 Feb. 1964 83 p refs Transl. into ENGLISH from Zh. Vses. Khim. Obshch-va. (Moscow), v. 8, no. 4, 1963 p 424–448
(JPRS-23440; OTS-64-21678) OTS: $2.00

Cancer chemotherapy has been found to be effective in the treatment of several malignant tumors. Chemotherapeutic preparations are usually used clinically only in treating late stages of the disease. However, in hemoblastoses, chemotherapy can be a valuable method from the initial stages. Available statistical data show that about 50% of malignant disease cases are now undergoing treatment with chemotherapeutic preparations in combination with other methods of treatment, or independently. R.T.K.

N64-15843* National Aeronautics and Space Administration. Langley Research Center, Langley, Va.
LIFE SUPPORT FOR LONG-DURATION MISSIONS
Dan C. Popma Repr. from Astronautics and Aerospace Eng., Aug. 19, 1963 p 53–56
(NASA RP-135)

A discussion is presented concerning the relation of present technology to life support for manned exploration of Mars and Venus. The discussion covers a number of possible systems for the support of man for long-term missions within the solar system, and relates them to the systems currently being developed for a manned space station and for other shorter-term missions. The tradeoff of weight as a function of time for these systems is discussed. A summary is given of the problems concerning man's influence on these systems. R.T.K.

N64-15856* National Aeronautics and Space Adminstration. Manned Spacecraft Center, Houston, Tex.
RAPID DECOMPRESSION HAZARDS AFTER PROLONGED EXPOSURE TO 50 PER CENT OXYGEN – 50 PER CENT NITROGEN ATMOSPHERE
Morris J. Damato, Francis M. Highly (Naval Air Eng. Center), Edwin Hendler, and Edward L. Michel Repr. from Aerospace Med. 1 v. 34, no. 11, Nov. 1963 p 1037–1040 refs

In rapid decompression followed by prolonged exposure to altitudes of 35,000 feet, the following procedures preceding the decompression have been found to minimize the incidence of bends: (1) breathing 100% oxygen for at least 3 hours at sea level; (2) breathing a 50% oxygen–50% nitrogen gas mixture for about 18 hours or more at an altitude equivalent of 18,000 feet; and (3) breathing 100% oxygen for 2 hours at sea level followed by breathing a 50% oxygen–50% nitrogen gas mixture for 12 hours at an altitude equivalent of 18,000 feet. During repeated exposures, recurrence of bends in the same area is very likely. The manifestation of bends may be delayed for more than 2 hours following decompression. Characteristic sensations of bends may be either localized in one area or may radiate eventually to involve more than one area simultaneously.
Author

N64-15873* Aeronutronic, Newport Beach, Calif.
STUDY OF BASIC BIO-ELECTROCHEMISTRY Quarterly Engineering Progress Report, 20 Sep.-19 Dec. 1963
M. H. Boyer, R. C. Bean, Y. H. Inami, and W. C. Shepherd 19 Jan. 1964 43 p refs
(NASA Contract NASw-655)
(NASA CR-55744; U-2479) OTS: $4.60 ph, $1.49 mf

A study has been made of the electrochemical activity of a number of enzyme systems, including D-amino acid, oxidase, urease, glucose oxidase, etc. The mechanisms of electrical energy production by amino acid, oxidase, and urease have been traced in detail, and the results are included in this report. The question of direct participation of biological macromolecules or bacterial cells in oxidation–reduction processes at electrodes is also investigated. The conditions under which direct participation of biological molecules might be observable are defined on the basis of theoretical considerations.
E.W.

N64-15889 Hofstra Coll., Hempstead, N.Y.
AUDITORY PAIN THRESHOLDS FOR INTERMITTENT "WHITE" NOISE
Robert Plutchik Feb. 1960 13 p refs
(Contract Nonr-2252(01))
(AD-236942)

Four subjects were asked to match the intensity of a white noise against pure tones of 1000, 2500, and 4000 cps, which were set at various known intensity levels ranging from 90 decibels to 120 decibels. A linear equation was found to approximate the matching data for all frequencies. The subjects were then required to indicate unpleasantness and pain thresholds using interrupted white noise at 3, 6, 10, and 15 pulses per second, as well as the thresholds for a pure tone at 1000 cps. The major results show: (1) Pain and unpleasantness thresholds for the 1000 cps tone are about 15 db lower than for the noise. (2) Pain and unpleasantness thresholds for interrupted pure tones are lower than for corresponding white noise. (This conclusion uses the data of a previous experiment for comparison.) (3) There seemed to be no difference in threshold as a function of pulse rates using white noise.
Author

N64-15895* Union Carbide Research Inst., Tarrytown, N.Y.
THE GENERAL AND COMPARATIVE BIOLOGY OF TERRESTRIAL ORGANISMS UNDER EXPERIMENTAL STRESS CONDITIONS Quarterly Report No. 2
S. M. Siegel 31 Dec. 1963 38 p
(NASA Contract NASw-767)
(NASA CR-52635) OTS: $3.60 ph, $1.34 mf

The topics discussed include: (1) anaerobiosis in seed germination—systematic and phylogenetic aspects, (2) germination in atmospheres containing nitrogen oxides, (3) effects of CO_2 and $CO_2 + O_2$ combinations on seedling growth, (4) germination and growth in atmospheres containing volatile organic compounds, and (5) the low temperature–hydrogen interaction effect on seed germination.
R.T.K.

N64-15902* Northrop Corp., Hawthorne, Calif.
INVESTIGATION OF PEROGNATHUS AS AN EXPERIMENTAL ORGANISM FOR RESEARCH IN SPACE BIOLOGY First Quarterly Progress Report, 1 Oct.-31 Dec. 1963
J. J. Gambino and R. G. Lindberg 1963 12 p refs
(NASA Contract NASw-812)
(NASA CR-55553; NSL-64-29-1) OTS: $1.60 ph, $0.80 mf

A series of *P. longimembris* were subjected to 1,400 r total body Co^{60} irradiation. One group was administered 100% oxygen at 3 atmospheres during the irradiation. Another was splenectomized prior to irradiation. A third group was forced to maintain its body temperature during the entire 30-day postirradiation period. Survivors occurred in all groups, suggesting that, taken singly, neither the hypoxia mechanisms or the lowered metabolic rate are responsible for the remarkable radiation resistance of *Perognathus*.
Author

N64-15914 Joint Publications Research Service, Washington, D.C.
CERTAIN PROBLEMS OF THE ORGANIZATION OF NEUROPSYCHIATRIC AID
E. A. Babyan and Z. N. Serebryakova 28 Feb. 1964 9 p Transl. into ENGLISH of an article from Zh. Nervopatol. i Psikhiatr. (Moscow), v. 64, no. 1, Jan. 1964 p 137–141
(JPRS-23446; OTS-64-21680) OTS: $0.50

The problems associated with setting up neuropsychiatric dispensaries in all oblast centers and cities with a population of at least 100,000 are discussed.
R.T.K.

N64-15955 London U., (Gt. Brit.) Inst. of Psychiatry
PHOSPHOPROTEIN METABOLISM IN CEREBRAL FUNCTIONING Final Technical Status Report (Fourth Quarterly) 1 Jul.-30 Sep. 1963
[1963] 9 p refs
(Contract DA-91-591-EUC-2716)
(AD-430174)

Further experiments have been carried out on the labeling of intrinsic microsomal phosphoproteins of cerebral cortex

with ^{32}P, using $AT^{32}P$ as precursor, under optimum conditions for the sodium and potassium stimulated ATPase reaction. The results show clearly that a major part of the microsomal phosphoproteins cannot be an intermediate in the hydrolysis of ATP by the ATPase, but do not exclude the possibility that a very small fraction is concerned. A method has been developed for rendering soluble some 30% of the microsomal proteins described from ox-brain cerebral cortex. This soluble fraction has been labeled with $AT^{32}P$ and fractionated by ammonium sulphate precipitation, and by ion-exchange chromatography on substituted celluloses. By both procedures a wide range of phosphoproteins was found, with only small differences in specific ^{32}P-radioactivity and P-content in the various fractions obtained. Author

N64-15976 Federal Aviation Agency, Oklahoma City, Okla. Civil Aeromedical Research Inst.

"IN VIVO" MEASUREMENT OF TOTAL GAS PRESSURE IN MAMMALIAN TISSUE

Michael T. Lategola Jul. 1963 8 p refs
(CARI-63-11)

An in vivo method for the quantitative estimation of total gas pressure in mammalian tissue has been established. This method utilizes a rigid-walled capsule specially constructed to be permeable to oxygen, carbon dioxide, and nitrogen (O_2, CO_2, and N_2), but negligibly permeable to water vapor. The results obtained at equilibrium, after subcutaneous implantation of this capsule, demonstrate directly that the total gas pressure in the adjacent tissue, which is represented by the intracapsular total gas pressure, is about 40 to 50 mm Hg less than the concomitant atmospheric pressure. The difference between these gas pressures is a result of the metabolic gas exchange and may, therefore, be used to detect quantitative changes in tissue gas metabolism. Author

N64-15992 Joint Publications Research Service, Washington, D.C.

EXTRACTS FROM "OCCUPATIONAL HYGIENE IN WORK WITH POLONIUM"

G. M. Parkhomenko 3 Mar. 1964 22 p refs Transl. into ENGLISH from the booklet "Gigiyena Truda Pri Rabote s Poloniyem" Moscow, 1963 p 16–22, 34–39, and 45–52
(JPRS-23499; OTS-64-21705) OTS: $0.75

The following subjects are discussed: (1) biological action of polonium; (2) maximum permissible concentrations and levels of irradiation; (3) work rules, measures of personal hygiene, and individual protective devices; and (4) therapeutic and preventive medical measures. R.T.K.

N64-15993 Walter Reed Army Inst. of Research, Washington, D.C. Behavioral Radiology Lab.

THE EFFECTS OF MASSIVE DOSES OF IONIZING RADIATION UPON CONDITIONED AVOIDANCE BEHAVIOR OF THE PRIMATE Technical Report No. 3

Joseph C. Sharp and Donald L. Daoust [1963] 31 p refs
(DASA-NWER-03.008)

Adult male primates (*Macaca mulatta*) were given massive and acute doses of whole-body irradiation to determine the irradiation effect on the performance of simple, highly motivated tasks that required periodic response. From the tests it is assumed that: complicated motor manipulations are severely attenuated by radiation; the shock-avoidance paradigm is a powerful motivator for animal experimentation in behavioral radiology; and the use of behavioral indexes is valid in the evaluation of the role of ionizing radiations in military and civil defense situations. C.L.W.

N64-15997 Atomic Energy Commission, New York, N.Y.

HEALTH AND SAFETY LABORATORY MANUAL OF STANDARD PROCEDURES

John H. Harley et al Aug. 1962 416 p refs
NYO-4700, Rev.) OTS: $5.50

This manual contains the methods that are used currently by the Analytical Branch of the Health and Safety Laboratory, U.S. Atomic Energy Commission. The manual also contains data that are useful to the radiochemist working with fallout debris. R.T.K.

N64-16002 Joint Publications Research Service, Washington, D.C.

METHODS USED IN ADMINISTRATION OF ELECTRICALLY INDUCED SLEEP

M. M. Zheltakov, Yu. K. Skripkin, and B. A. Somov 4 Mar. 1964 20 p Transl. into ENGLISH of the contents and ch. VI of the book "Elektroson i Gipnoz v Dermatologii" Moscow, Medgiz, 1963 p 99–113 and 307–308
(JPRS-23524; OTS-64-21717) OTS: $0.50

A review of the various methods used in administration of electrically induced sleep is presented. In addition a new, improved apparatus is described in which both the current strength and the frequency are regulated for every patient, i.e., every patient can be given current with a different pulse frequency (from 1 to 130 cycles). In this apparatus, a potentiometer that regulates the pulse frequency is provided for each of the four channels, and the current strength is measured in milliamperes. R.T.K.

N64-16095 Library of Congress, Washington, D.C.

BIBLIOGRAPHY OF BIOREGENERATING SYSTEMS FOR EXTRATERRESTRIAL HABITATION Technical Documentary Report [15 Aug. 1962–15 Sep. 1963]

Paul E. Spiegler Wright-Patterson AFB, Ohio, Biomedical Lab., Nov. 1963 99 p refs
(Contract AF 33(657)-62-397)
(AMRL-TDR-63-121; AD-430814) OTS: $2.50

This bibliography is a representative sampling of the world's literature covering the years 1959 to the present concerning the various aspects of extraterrestrial habitation. The 440 references deal with both the physiology and ecology of bioregenerating systems for space travel and the specific human requirements for extraterrestrial habitation. The section on the biology of bioregenerating systems contains papers on waste management and reutilization, gas-exchange mechanisms using different plants, culture techniques for producing food by utilizing tissues or plants, edibility of algae and various animals, toxicological aspects of waste and materials of construction, and environmental conditions on the moon. Papers dealing with specific human requirements include those on nutrition, food technology, and various topics of personal hygiene and sanitation. Author

N64-16098 Max-Planck-Institut für Immunbiologie, Frieburg (W. Germany)

RESEARCH ON THE PRODUCTION AND IMMUNOLOGICAL EXAMINATION OF ARTIFICIAL ANTIGENS CONTAINING KNOWN SUGARS (OR OLIGO-SACCHARIDES) AS THE DETERMINANT GROUPS. IN RELATION TO THE IMMUNOCHEMICAL ANALYSIS OF ENTEROBACTERIAL O-ANTIGENS (ENDOTOXINS) Final Technical Report, 1 Dec. 1962–30 Nov. 1963

Otto Westphal [1963] 9 p
(Contract DA-91-591-EUC-2770)
(AD-430401)

Efforts were concentrated on methods for the transformation of bacterial O-specific polysaccharide haptens into full

antigens. Two methods were worked out: (1) preparation of p-aminobenzyl ethers of the polysaccharides, which were then diazotized and coupled to proteins, giving polysaccharide benzylazo proteins; and (2) the polysaccharides were allowed to react with epichlorohydrine in slightly alkaline solution resulting in cross-linking of polysaccharide units to larger (soluble or insoluble) particles. Studies were also carried out on the influence of certain substituents (after their introduction into the polysaccharides) with respect to the antigenicity of the artificial polysaccharide complexes. Special emphasis was put on the esterification of the polysaccharide component with long-chain fatty acids. R.T.K.

N64-16109* Melpar, Inc., Falls Church, Va.
RESEARCH ON DETECTION OF EXTRATERRESTRIAL LIFE BY ULTRAVIOLET SPECTROPHOTOMETRY Final Report
Jan. 1964 60 p refs
(NASA Contract NASw-571)
(NASA CR-55655) OTS: $5.60 ph, $2.00 mf

A research program was carried out to determine the feasibility of applying absorption of far ultraviolet radiation by peptides to the detection of extraterrestrial life on Mars. Experiments were carried out on a variety of amino acids, dipeptides, tripeptides, polypeptides, and proteins. It was found that all substances containing peptide bonds showed an absorption maximum in the 185 mμ to 190 mμ region. A suspension of *Staphylococcus aureus* and extracts of local soil and sand also showed an absorption in this region. Experiments with substances that might give false positive absorptions showed that many nonpeptides similarly absorb in this region. However, it was observed that hydrolysis of the peptides resulted in a decrease in absorbancy, as did hydrolysis of the extracts of soil and sand. This effect allows for the distinction between peptides and nonpeptides. The effect of pH was studied, and it was found that the carboxyl ion absorbed in this same far ultraviolet region. Acidification to a pH well below the pK of a carboxylic acid resulted in the elimination of this absorption. Author

17 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and materials fabrication, handling and inspection. *For related information see*: 06 Auxiliary Systems.

N64-15007 Joint Publications Research Service, Washington, D.C.
OBTAINING POWDERS FROM CARBONYLS AND OTHER PHYSICO-CHEMICAL METHODS OF PREPARATION OF POWDERS
Ivan Mikhaylovich Fedorchenko and Rotislav Aleksandrovich Andriyevskiy *In its* Studies in Powder Met. 28 Jan. 1964 p 1–5 ref (See N64-15006 07-01) OTS: $2.25

The positive characteristics of the carbonyl method of production are: the high purity of carbonyl powders, the possibility of producing spherical particles, the possibility of obtaining alloyed powders, the use of inexpensive and readily available raw materials, and the good sinterability of the powders. However, the cost of producing carbonyl powders remains high, and this limits their industrial application. R.T.K.

N64-15008 Joint Publications Research Service, Washington, D.C.
PHYSICAL PROPERTIES
Ivan Mikhaylovich Fedorchenko and Rotislav Aleksandrovich Andriyevskiy *In its* Studies in Powder Met. 28 Jan. 1964 p 6–41 refs (See N64-15006 07-01) OTS: $2.25

The physical properties of metals are discussed. Included are: (1) particle size and distribution of metal powder particles according to fractions—screening of powder on sieves, microscopic methods, sedimentation methods, (2) particle shape, (3) microhardness, (4) specific surface, (5) pycnometric density, and (6) state of the crystal lattice of metal powders. R.T.K.

N64-15009 Joint Publications Research Service, Washington, D.C.
ROLLING OF METAL POWDERS
Ivan Mikhaylovich Fedorchenko and Rotislav Aleksandrovich Andriyevskiy *In its* Studies in Powder Met. 28 Jan. 1964 p 42–58 refs (See N64-15006 07-01) OTS: $2.25

The process of rolling powder from its entry into the rollers until its emergence from the roller can be separated into three periods: the initial nonsteady state, steady state, and final nonsteady state. Data are presented on: (1) the variation of the thickness of ribbon rolled from iron powder according to length in the initial and final periods, (2) the dependence of the density and thickness of ribbon rolled from iron powder of various granularities on the size of the gap between the rollers, and (3) the effect of deformation on the properties of rolled and sintered ribbon from copper powder. R.T.K.

N64-15022 Deutsche Forschungsanstalt für Luft- und Raumfahrt, Brunswick, (W. Germany) Inst. für Flugzeugbau
THE POSSIBILITIES OF NONDESTRUCTIVE TESTING OF GLUED METAL JOINTS [DIE MOGLICHKEITEN DER ZERSTORUNGSFREIEN PRUFUNG VON METALLKLEB-VERBINDUNGEN]
H. Meckelburg and W. Althof 1963 60 p refs in GERMAN
(DFL-216)

A literature survey is presented of the possibilities for nondestructive testing of bonded metal joints and the practical application thereof. The supersonic testing method appears particularly suitable and has already been used extensively in industrial manufacturing. Trans. by I.v.L.

N64-15023 Deutsche Forschungsanstalt für Luft- und Raumfahrt, Brunswick, (W. Germany) Inst. für Flugzeugbau
THE NONDESTRUCTIVE TESTING OF GLUED METAL JOINTS WITH ULTRA SOUND-IMPULSE-ECHO-APPARATUSES [DIE ZERSTROUNGSFREIE PRUFUNG VON METALLKLEBVERBINDUNGEN MIT ULTRASCHALL-IMPULS-ECHO-GERATEN]
W. Althof 1963 79 p refs In GERMAN
(DFL-217)

Metal-to-metal bonding and bonding of cover plates or honeycomb plates were nondestructively tested with a supersonic-impulse-echo apparatus. Various testing methods were employed, such as testing with plate waves in reflection tests and testing with a sender-receiver-sound head in reflection tests. Defects in the adhesive layer, the difference in thickness of the layer, and the porostity of the layer were clearly shown. The hardening of the adhesive layers under or above the specified temperature caused no changes in the recording of the apparatus. Differences in the adhesion between joint sections and the adhesive layer were not shown. Trans. by I.v.L.

N64-15049 Joint Publications Research Service, Washington, D.C.
PROBLEMS OF INGOT TEMPERATURES
V. V. Panin et al 5 Feb. 1964 21 p refs Transl. into ENGLISH of 2 articles from Izv. Vysshikh Uchebn. Zavedeni., Chern. Met., (Moscow), no. 9, Sep. 1963 p 77–87
(JPRS-23089; OTS-64-21489) OTS: $0.50

Two papers dealing with electroslag melting are presented: (1) "Investigation of Temperature Fields in an Electroslag Ingot"; and (2) "Some Thermal Engineering Problems of Ingot Solidification in Electroslag Remelting." In (1) it is indicated that: (a) Upon admission of heat to the slag bath only, a shallow bath is formed with a flat bottom and with a depth that is almost linearly related to slag temperature. (b) The metal bath depth depends, to a large extent, on the heat carried into the bath by metal drops and, to a less degree, on slag temperature. (c) The boundary between liquid and solid phases occurs somewhat below the line of intersection of the face and external surface of the ingot. In determination of (2), the temperature fields and depth of the metal bath for an ingot with a diameter of 100 mm indicated that: (1) Given an identical heat flow of 66,000 kilo-cal/hr, an increase in the share of the heat introduced by metal droplets from 0% to 28% results in a fourfold increase in the depth of the bath. (2) With a heat flow of 87,000 kilo-cal/hr, and 28% of the heat being transferred by metal drops, the depth of the metal bath was 55 mm; with a heat flow of 66,000 kilo-cal/hr the depth was 32 mm. P.V.E.

N64-15050 Joint Publications Research Service, Washington, D.C.

DYNAMIC CHARACTERISTICS OF A SUB-POLAR FRONT IN THE NORTH ATLANTIC

V. M. Gruzinov and K. A. Chekotillo 6 Feb. 1964 7 p Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 153, no. 6, 21 Dec. 1963, p 1307–1309
(JPRS-23109; OTS-64-21501) OTS: $0.50

A discussion is presented of an investigation to determine the criterion to be assumed in determining a front in the ocean, with respect to dynamic characteristics. Calculated positions of the subpolar front in the North Atlantic for spring and autumn at a depth of 200 meters are shown in graphic form. P.V.E.

N64-15072 Naval Research Lab., Washington, D.C.

FILTERABILITY OF DISTILLATE FUELS. PART 2: EFFECT OF FUEL VISCOSITY AND RELATED FACTORS

A. J. Chiantella and J. E. Johnson 12 Sep. 1963 22 p refs
(NRL-5971; AD-421925) OTS: $0.50

Studies of additional factors influencing filterability of distillate fuels further substantiate the utility of a constant-head gravity-flow method for rating filterability. Quantitative relationships were made possible by selecting filter papers of uniform porosity. It was shown that the filterability of a distillate fuel contaminated by a given amount of sediment is directly proportional to the fuel viscosity. The effect of temperature on filterability was proven to be due to the variation of viscosity with temperature. Filterability is also directly proportional to the fuel pressure (head) on the filter. It was shown that variations in filter porosity could be balanced by proper adjustment of fuel head. No significant change in fuel viscosity was found due to aging, either normal or accelerated. It is proposed, therefore, that changes in fuel filterability due to aging are due to accumulation of insoluble residues in the fuel. Author

N64-15075 Naval Radiological Defense Lab., San Francisco, Calif.

AHIGH-VACUUM GAS-INLET APPARATUS FOR GAS CHROMATOGRAPHY

J. F. Pestaner, W. E. Shalberg, and R. Y. Yahiku 28 Oct. 1963 11 p refs
(USNRDL-TR-692; AD-425556)

A reliable gas-inlet apparatus is described for introducing micromolar gas samples quantitatively into a gas chromatograph. Author

N64-15123 Clevite Corp., Waltham, Mass. Semiconductor Div.

PRODUCTION ENGINEERING MEASURE FOR THE IMPROVEMENT OF GERMANIUM ALLOY POWER TRANSISTOR Fifth Quarterly Progress Report, 30 Apr.–31 Jul. 1963

Richard D. Silverman [1963] 80 p refs
(Contract DA-36-039-SC-86724)
(AD-429044)

Further work is discussed on the cleaning procedure involving etching variants and changes in the drying technique. Three methods of reducing the internal relative humidity of the transistor package are outlined. The redesigned internal clip is evaluated. Redesign of the collector pellet, resulting in a solution to the high collector current leakage problem, is described. Test results are given of units assembled with component piece parts stored in various ways prior to assembly. The newly installed production method is outlined for material handling of transistor subassemblies through the fusing and first electrical testing operations. The effectiveness of the improved vendor and internal production process control techniques is discussed. A display of process average information relating to weld and terminal leak control is provided for evaluation. Author

N64-15164 Army Materials Research Agency, Watertown, Mass. Materials Testing Lab.

DEVELOPMENT OF EDDY CURRENT INSPECTION EQUIPMENT Technical Report

Robert C. Grubinskas Nov. 1963 26 p refs
(AMRA-TR-63-24; AD-425700)

An eddy-current test system has been developed utilizing commercially available instruments as integral components. Emphasis has been placed upon the development of a versatile system that is capable of solving numerous specific inspection problems. Coil design studies have resulted in the development of alterable coil forms and a versatile eddy current test probe. The test system, employing both encircling and probe coils, has been applied to various nonferromagnetic materials, such as aluminum, brass, copper, magnesium, and titanium, with satisfactory results. Author

N64-15177 Bureau of Mines, Minneapolis, Minn.

EXPERIMENTAL UPGRADING OF ARTIFICIAL MAGNETITE CONCENTRATES BY FLOTATION

D. W. Frommer and A. F. Colombo 1964 17 p refs
(BM-RI-6349)

Bench-scale tests were made to determine the applicability of flotation as a means of upgrading finished and semi-finished magnetic concentrates prepared from reductively roasted iron ores. Both anionic and cationic flotation methods were used to remove siliceous gangue from the magnetic concentrates and produce upgraded products. Seven magnetic concentrates, containing from 6.7% to 13.7% SiO_2, were improved by the flotation treatment, yielding final concentrates containing less than 6.0-percent SiO_2. Cationic flotation methods were studied on four of the seven samples; of this group only one sample yielded better results by cationic flotation than by the anionic method. Author

N64-15199 Aerojet-General Nucleonics, San Ramon, Calif.

ARMY GAS-COOLED REACTOR SYSTEMS PROGRAM. ML-1 PRESSURE VESSEL REPAIR Summary Report

R. H. Chesworth Dec. 1963 68 p refs
(Contract AT(10-1)-880)
(AGN TM-405) OTS: $1.50

Evidence of a leak between the coolant gas area and the moderator area of the ML-1 reactor was observed in March

1963. The pressure vessel was removed from the reactor skid, and the source of the leak was identified and repaired. The reactor skid was reassembled, with certain modifications, and was available for continued operation in mid-September 1963. Author

N64-15227* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
INTRODUCTION AND DEFINITION OF NEWER PROBLEM AREAS
Edmond E. Bisson *In its* Advanced Bearing Technol. 1964 p 1–13 refs (See N64-15226 07-01) GPO: $1.75

Some of the fundamentals of bearing technology are discussed, and current and anticipated problems in the field of bearings are closely examined. Properties of lubricants and bearings are discussed for three mission areas—aircraft, missiles, and spacecraft. C.L.W.

N64-15228* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
BOUNDARY LUBRICATION
Edmond E. Bisson *In its* Advanced Bearing Technol. 1964 p 15–61 refs (See N64-15226 07-01) GPO: $1.75

Boundary lubrication is examined in considerable detail. The fundamental principles involved in friction are presented; the various mechanism of wear are discussed; and the effect on friction, wear, and surface damage of adsorbed gases, liquid monolayers, adsorbed and chemisorbed films, and solid solubility of the material combination is shown. Also demonstrated is the relationship of surface films of various types to the friction, wear, and surface damage of sliding metals. C.L.W.

N64-15232* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
ROLLING-ELEMENT BEARINGS
William J. Anderson *In its* Advanced Bearing Technol. 1964 p 139–173 refs (See N64-15226 07-01) GPO: $1.75

The principles of operation, types, advantages, disadvantages, and other characteristics associated with rolling-element bearings are given. In this discussion, the rolling-element bearings are placed into two broad categories—ball bearings and roller bearings. The common types of ball bearings are listed as deep groove or conrad, angular contact, self aligning, duplex, and ball thrust. The roller bearings are listed as cylindrical, tapered, spherical, and needle. Included are discussions of rolling friction, friction losses in rolling bearings, contact stresses, deformations, kinematics, load distribution, specific dynamic capacity and life, specific static capacity, and lubrication. C.L.W.

N64-15235* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
FRICTION AND BEARING PROBLEMS IN THE VACUUM AND RADIATION ENVIRONMENTS OF SPACE
Edmond E. Bisson *In its* Advanced Bearing Technol. 1964 p 259–287 refs (See N64-15226 07-01) GPO: $1.75

A general discussion is given of the friction and bearing problems that result from the exposure of mechanisms to the vacuum or radiation environments of space. Some of the problems can be eliminated by design techniques, such as the use of hermetically sealed systems, but this solution is not always possible because of its complexity and weight disadvantages. The discussion concerns finding better solutions involving self-lubricating materials or limited-life lubricants. C.L.W.

N64-15236* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
FRICTION OF METALS, LUBRICATING COATINGS, AND CARBONS IN LIQUID NITROGEN AND HYDROGEN
Edmond E. Bisson *In its* Advanced Bearing Technol. 1964 p 289–307 refs (See N64-15226 07-01) GPO: $1.75

Data from friction and wear studies on various material combinations in liquid nitrogen and in liquid hydrogen are discussed. Friction and wear data were obtained with three common metals in liquid nitrogen. These data show that, with types 304 austenitic stainless steel sliding on 304, the wear of the rider specimen is fairly high. With two other steels, type 52100 conventional bearing steel sliding on 52100 and type 440C stainless steel sliding on 440C, wear was lower than with type 304 on 304. The wear and friction properties of austenitic steel with various surface coatings in liquid nitrogen were investigated, and the results are reported. Wear and friction investigations were also conducted with solid bodies of various plastics and of impregnated carbons in liquid nitrogen and liquid hydrogen. C.L.W.

N64-15237* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
EXTREME-TEMPERATURE BEARINGS
William J. Anderson *In its* Advanced Bearing Technol. 1964 p 309–370 refs (See N64-15226 07-01) GPO: $1.75

Approaches are discussed of bearing-operation problems in the areas from −65° F down to temperatures approximating those of liquid helium, and from temperatures of 400° F up to an absolute maximum of 3,000° F. Results obtained by various investigators in the field are examined. The discussion concerning low-temperature bearings included friction and wear experiments, high-speed bearing experiments, and the general design philosophy of bearings for use in cryogenic applications. In the high-temperature region, applications included those at low rotative speeds or oscillating motion and a very high load. The discussion covers materials, lubricants, and bearing designs—three major problems that are encountered in operating rolling contact bearings at high temperatures. C.L.W.

N64-15297 General Motors Corp., Kokomo, Ind.
PRODUCTION ENGINEERING MEASURE TO IMPROVE PRODUCTION TECHNIQUES AND INCREASE THE RELIABILITY OF THE 2N1358A TRANSISTOR Quarterly Progress Report No. 6, 30 Jul.-30 Oct. 1963
J. C. Kuhns [1963] 33 p
(Contract DA-36-039-SC-86725)
(AD-423651)

Facilities for all 17 of the active process and equipment programs are completed and capable of producing; 14 are used in standard daily production, and the remaining 3 are used to produce special runs for evaluation purposes. Two of the programs instituted into standard production are providing evidence of significant reliability improvement. The new mounting furnace utilizing superheated hydrogen is favorably affecting the d.c. operating-life capabilities of the device. The surface treatment program was expanded beyond the original program and now includes surface passivation ambient control (SPAC) facilities. Failure rates and graphs of parameter distributions of Milestone IV tests are included. Results of a special test to analyze d.c. operating-life test equipment are reported. Author

N64-15733* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
RELIABLE ELECTRICAL CONNECTIONS Technology Handbook

James A. Gay, Jr. Washington, NASA, Dec. 1963 78 p 3d ed. (NASA-SP-5002) OTS: $0.70

Diagrams, photographs, and detailed instructions covering the techniques of different kinds of electrical connections are given in this handbook. R.L.K.

N64-15858 Fairchild Semiconductor Corp., Mountain View, Calif.

Final Report, 1 May 1962-31 Oct. 1963, Volume II [PRODUCTION ENGINEERING MEASURE 2N914 AND 2N995 TRANSISTORS]

J. Schroeder et al [1963] 257 p ref
(Contract DA-36-039-SC-86726)
(AD-429921)

A three-step process is described for the preparation of silicon substrates prior to epitaxy. The process involves monitoring saw damage in silicon slices by the mechanical chemical damage-test procedure, mechanical chemical polishing of slices, and vapor etching of wafers prior to epitaxial deposition. The complete process, when used as a wafer preparation program, will ensure device reliability because of the positive elimination of saw damage, crystal defects, and surface contamination at the interface of the epitaxial and substrate material. Author

N64-15868* Rohr Corp., Chula Vista, Calif.

A STUDY TO DETERMINE THE OPTIMUM METHOD FOR FORMING CLOSED-RIBBED PLATE TO CYLINDRICAL AND SPHERICAL SHAPES Final Report, 8 Jul.-7 Nov. 1963

G. S. Greene and S. J. Domin 7 Nov. 1963 59 p refs
(NASA Order T.P.-3-82403)
(NASA CR-55749) OTS: $5.60 ph, $1.97 mf

The study was conducted in relation to the production of missile components. Results indicate that: (1) Explosive and shot-peen forming would require extensive feasibility and developmental programs. (2) Simultaneous age-forming and creep-forming methods are feasible and are being developed. (3) Closed-ribbed shapes can be contoured to cylindrical shapes by standard press brake- and roll-forming equipment. (4) Derived tension and compression limits indicate that the stretch-wrap-forming method will alow closed-ribbed panels to be formed to smaller radii than either roll- or brake-forming methods. (5) The derived strain theory, which provides a geometrical solution of the forming predictability for stretch, roll, and brake forming, appears to be the correct approach. Charts of the derived tension and compression limits for roll, press, and stretch forming are presented for all alloys included in the investigation. I.v.L.

N64-15911 Los Alamos Scientific Lab., N. Mex.

DEOXIDATION OF TANTALUM WITH SOME REACTIVE METALS

Ralph H. Perkins 10 Feb. 1964 36 p refs
(Contract W-7405-eng-36)
(LAMS-3022) OTS: $0.75

Calcium and calcium–magnesium (18 wt.% Mg) were more satisfactory than lithium as gettering agents; in 200 hours at 900° C they reduced the oxygen levels in 0.20-in.-diam. tantalum samples from several hundred parts per million to about 20 parts per million. However, the high vapor pressures of these metals at 900° C complicated their use. A cerium–cobalt alloy (12 wt.% Co) was not satisfactory because of the formation of a layer of Ta_6Co_7 on the surface of the tantalum. Cerium proved to be the most satisfactory deoxidizing agent; at 900° C it has a very low vapor pressure, and it can also reduce the oxygen level in tantalum to about 20 ppm at this temperature in 200-hours exposure time. None of the getters lowered the oxygen content of tantalum below 15 ppm under the experimental conditions that were studied. Author

N64-15922 Bureau of Mines, Albany, Ore.

REDUCING VANADIUM COMPOUNDS IN BOMB REACTORS

T. T. Campbell, F. E. Block, and E. R. Andersen 1964 30 p refs
(BM-RI-6374)

Compounds reduced were V_2O_5, V_2O_3, VCl_2, and VCl_3. Sodium, calcium, and magnesium were used as reductants. Variables considered included reductant form, bomb size, pressure during reaction, method of ignition, and the use of slag fluidizing additives. It was concluded that yields of 85 to 90 percent can be effected by the calcium reduction of V_2O_5 in reactors measuring as much as 14 in. in diameter and 60 in. in height. Purity of the vanadium produced in large reactors varied from 99.5 to 99.8 percent. Although high yields of up to 99.5 percent can be effected by bomb reduction of VCl_3, the high pressures developed in the bombs and attack of the reactor walls by the byproduct chloride slags discourage this method of preparing vanadium. It was found that significant purification of impure regulus metal occurred when it was hydrided, crushed, acid leached, and vacuum dehydrided. Metal so treated can readily be converted to ductile sheet. Author

N64-15948 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

PRODUCTION TECHNOLOGY OF MINIATURE GYROMOTORS

S. A. Zholdak 15 Jan. 1964 362 p refs Transl. into ENGLISH from the book "Tekhnologiya Izgotovleniya Malogabaritnykh Giromotorev" Leningrad, Gos. Soyuzn. Izd. Sudostroitel'noy Prom., 1961 p 1–267
(FTD-TT-62-859/1+2; AD-429103)

The present volume considers problems of the production technology of components and units and also the assembly and testing of one of the basic elements of any gyroscopic instrument—the gyromotor. The principal attention is devoted to the technology of the miniature electric gyromotor. Devices used to ensure high manufacturing precision are described. Author

N64-15963* Sippican Corp., Marion, Mass.

IMPROVED TECHNIQUES FOR INTERCONNECTING SOLAR CELLS Study Report

Jan. 1964 24 p
(NASA Contract NASw-798)
(NASA CR-53077; R-268) OTS: $2.60 ph, $0.92 mf

The intent of this investigation was to develop a tough, durable weld between a solar cell and a flexible conductor, with the aim of eventually developing a connection that could be used to fabricate a flexible solar-battery assembly. The first series of experiments was performed with a laser welder, followed by a comparable series of experiments using modified equipment that lengthened the laser pulse duration. Due to problems associated with materials and fixturing, it was concluded that laser equipment is not sufficiently developed for fully reliable solar-cell joining applications. Joining experiments were also conducted with a parallel gap welding machine. The inherent ability of this equipment to hold the materials during welding eliminates the fixturing problems associated with the laser welder. The potential of the parallel gap welding machine is high for making a strong, ductile interconnection. C.L.W.

N64-15980 Lockheed Missiles and Space Co., Sunnyvale, Calif.
FUSION WELDING OF ALUMINUM: AN ANNOTATED BIBLIOGRAPHY [1962-JUN. 1963]
Helen B. Mc Cormick and Peter R. Stromer, comps. Jul. 1963 27 p refs
(SB-63-56; Rept. 8-30-63-2)

This bibliography (62 refs.) has been compiled on the fusion welding of aluminum alloys, with emphasis on references reporting the latest advances in the Tunsten-Inert-Gas (TIG) process using either alternating current or direct current straight polarity. Entries are arranged alphabetically by senior personal author or by journal article title when no author is given. A subject index is included. Author

N64-15999 National Lead Co. of Ohio, Cincinnati
SUMMARY TECHNICAL REPORT FOR THE PERIOD OCTOBER 1, 1963 TO DECEMBER 31, 1963 AEC Research and Development Report
R. Burgett, ed. 17 Feb. 1964 55 p refs
(Contract AT(30-1)-1156)
(NLCO-900) OTS: $1.50

The following reports are included: (1) Improvement of Production Furnace Induction Coil Assembly—An improved, encapsulated, induction coil assembly eliminated arcing and improved thermal efficiency. (2) Vacuum Remelt Recovery of Ingot Crops—Uranium ingot crops were satisfactory as feed for the remelt operation after first being vacuum remelted. (3) Measuring Remelt Pour Temperatures by Use of an Infrared Radiation Pyrometer—An infrared radiation pyrometer sighted on the crucible pour plug was used to control the cycle of a vacuum induction remelt furnace. (4) Multiple Beta Heat Treatment of Hapo Hollow Fuel Core Blanks—Hapo hollow core blanks were subjected to as many as 30 alpha-to-beta-to-alpha cycles. Although the cores underwent dimensional changes, no internal voids were produced. (5) Induction Heat Treating of Hanford Hollow Fuel Cores—A large quantity of Hapo cores was beta heat-treated by induction and quenched in oil. The heat-treated cores had fine grains and uniform structures. (6) The Electrochemical Machining of Uranium—Uranium was machined electrochemically in a preliminary offsite test. R.T.K.

N64-16034* Mechanical Technology Inc., Latham, N.Y.
LUBRICATION ANALYSIS IN TURBULENT REGIME Second Quarterly Report
E. B. Arwas, F. K. Orcutt, and J. H. Vohr 24 Jan. 1964 83 p refs
(NASA Contract NASw-771)
(NASA CR-55803; MTI-64TR3) OTS: $8.10 ph, $2.69 mf

Two auxiliary computer programs were written to facilitate the reduction of the dynamic-load test data. The first program uses the readings of each set of eight data points to compute the corresponding values of the eight spring and damping coefficients, for direct comparison with the theoretical values of the coefficients. The second program is based on an analysis (presented in an appendix) wherein the sets of eight spring and damping coefficients are reduced to sets of four equivalent spring and damping coefficients. An initial set of steady-state load tests were conducted with the 360° plain circular bearing with an oil-inlet feed hole at the top of the bearing. Steady-state load tests were conducted with a 4-in.-diameter, 4-in.-long, 100° partial-arc bearing with 2×10^{-3} in./in. clearance ratio, over a range of mean clearance Reynolds numbers from 1,665 to 8,314. The agreement between experimental and theoretical load capacity was generally very good and provided encouraging verification of the theory. Transition from a laminar to a vortex regime was obtained at eccentricity ratios from 0 to 0.891; the resulting data are presented. A derivation of the linearized turbulent lubrication equation is also presented in an appendix. P.V.E.

N64-16042 Northrop Corp., Hawthorne, Calif. Norair Div.
QUARTZ LAMP RADIANT HEAT BRAZING OF LARGE REFRACTORY METAL HONEYCOMB SANDWICH PANELS Interim Engineering Progress Report, 10 Oct. 1962-10 Jan. 1963
D. B. Hugill and B. Gaiennie Wright-Patterson AFB, Ohio, Mfg. Tech. Lab. [1963] 89 p refs
(Contract AF 33(657)-8910)
(IR-7-937A(11); AD-295703)

Investigation has demonstrated that diffusion-bonded honeycomb core can be produced, and that successful brazing can be accomplished under time, temperature, and inert gas atmosphere conditions representative of the quartz-lamp radiant brazing system. Sound diffusion bonds for honeycomb core manufacture can be made from 2 mil D-36 and TZM foil using a 30μ in. or greater deposit of titanium as an interface agent. No recrystallization of the TZM alloy occurs from the bonding cycle. Recrystallization studies on TZM show a Nortobraze cycle of 2,400° F will limit recrystallization effects to the extent that satisfactorily ductile structural panels will result. Author

N64-16079 Allegheny Ludlum Steel Corp., Brackenridge, Pa. Research Center
EXTRUDING AND DRAWING MOLYBDENUM TO COMPLEX THIN H-SECTION Second Interim Technical Engineering Report, 1 Oct.-31 Dec. 1963
P. A. Santoli Wright-Patterson AFB, Ohio, Res. and Technol. Div., Jan. 1964 38 p refs
(Contract AF 33(657)-11203)
(RTD-TR-8-112(2); AD-430309)

Sixteen solid round extrusions of TZM were made primarily to determine suitable die materials. Reduction ratios at 45:1 and 55:1 were accomplished from a billet heating temperature range of 3,000° to 3,500° F. Extrusion dies were prepared with flame-sprayed zirconia deposits on AISI H-13 tool steel and with pressed and sintered solid zirconia nibs. Good extrusion results were obtained with the use of .025-in. and .035-in. sprayed zirconia at a reduction ratio of 45:1. Extrusions at 55:1 were poor regardless of sprayed-coating thickness and billet-heating temperature. Good extrusion results were also obtained with pressed and sintered solid zirconia nibs at a reduction of 45:1. Extrusion tooling performed well up to 237,000 psi liner pressure, except for noticeable wear that occurred at the liner working surface. Author

N64-16087 SKF Industries, Inc., King of Prussia, Pa. Engineering and Research Center
INFLUENCE OF LUBRICATION ON ENDURANCE OF ROLLING CONTACTS Progress Report No. 8, Jun. 22, 1963-Sep. 22, 1963
E. F. Brady, J. Mc Cool, L. B. Sibley, and R. Valori [1963] 73 p refs
(Contract NOw-61-0716-C)
(AL64T003; AD-430287)

Rolling 4-ball endurance conductivity, and wear tests were continued. Radiotracer wear data were obtained at low-speed (2,500 rpm) endurance test conditions. Conductivity tests were also performed at this and adjacent speeds. A blended Primol decalin lubricant with 15.4 cs viscosity at 34° C was used. It was found that asperity contacts are not maintained through the oil at 2,500 rpm once the balls have been thoroughly run in. For this reason, a thinner oil is being blended and will be used in future tests. Author

18 MATERIALS, METALLIC

Includes cermets; mechanical and physical properties of alloys and metals; and metallurgy. *For related information see*: 07 Chemistry; 17 Machine Elements and Processes; 19 Materials, Nonmetallic; 33 Stresses and Loads; and 34 Structural Design.

N64-15010 Joint Publications Research Service, Washington, D.C.
PROPERTIES OF SINTERED BODIES
Ivan Mikhaylovich Fedorchenko and Rotislav Aleksandrovich Andriyevskiy *In its* Studies in Powder Met. 28 Jan. 1964 p 59–84 refs (See N64-15006 07-01) OTS: $2.25

The topics discussed include: (1) general principles of the change in properties during sintering, (2) the influence of porosity on the properties of sintered bodies, and (3) instruments for measurement of properties of sintered bodies. R.T.K.

N64-15104 Naval Ordnance Lab., White Oak, Md.
INTERMETALLIC COMPOUND BASED MATERIALS FOR STRUCTURAL APPLICATIONS
W. J. Buehler In ONR Solution to Navy Probl. through Advanced Technol. [1963] p 1–30 refs (See N64-15101 07-01) OTS: $5.00

The intermetallic compound containing equiatomic quantities of titanium and nickel, TiNi, showed unique properties that included marked ductility at room temperature. This compound and its nickel-rich variations are discussed. TiNi-base compound materials were found to be useful engineering materials, which could easily be produced commercially. R.T.K.

N64-15240* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
LUBRICATION OF BEARINGS WITH LIQUID METALS
William J. Anderson *In its* Advanced Bearing Technol. 1964 p 469–496 refs (See N64-15226 07-01) GPO: $1.75

Fluids primarily considered for use as cycle working fluids are mercury and the alkali metals—rubidium, potassium, sodium, and lithium. The properties of liquid metals that can affect the performance of bearings are their low viscosity and their corrosivity. The alkali metals reduce most metal oxides, and the high mass density of mercury tends to promote erosion because of high particle inertia. The discussion includes types of bearings, bearing experiments, properties of bearing materials, properties of liquid metals, and operating problems. C.L.W.

N64-15376 Aerojet-General Corp., Azusa, Calif. Von Karman Center
STRESS-CORROSION CRACKING OF HIGH-STRENGTH ALLOYS Eleventh Quarterly Progress Report, 1 Oct.–31 Dec. 1963
R. B. Setterlund and A. Rubin Jan. 1964 21 p refs
(Contract DA-04-495-ORD-3069)
(Rept. 0414-02-2; AD-429296)

The current program status is: (1) Triplicate bent-beam U-bend specimens of RMS 200 heat number 3960523, Vascomax 250 heat number 07868, Marvac 18 heat number C56858, and Vascomax 300 heat number 07268 were exposed to aerated distilled water, aerated 3%-sodium chloride, and 140° F water-saturated air. The most severe test condition was found to be water-saturated air. All specimens of the four heats failed. (2) Ambient tests in distilled water at 120° F have been initiated on 18%-nickel maraging steel, a low-alloy martensitic steel (D6AC), and hot-worked die steel (Vascojet 1000). (3) A preliminary test for the chemical changes occurring in 18%-nickel maraging steel has been conducted on a center-notched specimen of heat 3960502. As the stresses at the crack tip increased by deadweight loading of the specimen, the metal was found to become more chemically active. (4) Three coating systems, polyurethane, zinc, and inhibited epoxy, are being evaluated on a single heat of 18%-nickel maraging steel. I.v.L.

N64-15392 Bettis Atomic Power Lab., Pittsburgh, Pa.
EFFECT OF HYDROGEN AND HYDRIDE MORPHOLOGY ON THE TENSILE PROPERTIES OF ZIRCALOY-2
W. J. Babyak, W. F. Bourgeois, and G. J. Salvaggio Nov. 1963 49 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-275) OTS: $1.25

The effects of both hydrogen concentration and hydride morphology on the tensile properties of both alpha-annealed and beta-quenched Zircaloy-2 have been experimentally determined at room temperature and at 500° F in order to assess the critical hydrogen level that would limit the useful lifetime of Zircaloy-2 in pressurized water reactors. Three hydrogen levels, approximately 15, 275, and 550 ppm, with the precipitated hydride either predominantly at grain boundaries or uniformly distributed within the grains, were investigated. Based on a comparison of the tensile strength of notched and unnotched specimens and an evaluation of the ductility values, the limiting hydrogen content of Zircaloy with grain boundary hydrides is 250 ppm. In general, the deleterious effects of hydrogen are less pronounced when the hydrides are uniformly distributed; therefore, under these conditions the limit can be extended to greater than 250 ppm. Author

N64-15499 Metals and Controls, Inc., Attleboro, Mass.
DEVELOPMENT OF OPTIMUM PROCESSING PARAMETERS FOR REFRACTORY METAL FOIL Interim Summary Report, 1 Jun. 1962–1 May 1963
J. J. Buchinski and G. P. Trost Oct. 1963 126 p refs
(Contract AF 33(657)-9384)
(ASD-TDR-63-829, Pt. 1; AD-425857)

Quality specifications for both the starting reroll stock and finished columbium-base alloy foil were established. Roll processing schedules, associated rolling mill variables, flattening procedures, and cleaning techniques were also studied. Processes for producing foil meeting high standards of surface quality and thickness tolerance were developed. Flatness of foil was felt to be one of the major remaining problems, along with the annealing. Interstitial pickup in the final foil was of a low to moderate level, with the result that mechanical property changes between reroll stock and finished foil were very small. Author

N64-15527 Joint Publications Research Service, Washington, D.C.
RHENIUM
K. B. Lebedev 25 Feb. 1964 250 p refs Transl. into ENGLISH from the monograph "Reniy" Moscow, Metallurgizdat, 1963, p 1–208
(JPRS-23361; OTS-64-21632) OTS: $3.50

This book presents information on the properties, applications, sources, production methods, and analytical chemistry of rhenium. It is intended for engineering and scientific workers in the fields of the geology, metallurgy, and chemistry of the rare and less-common elements. Author

N64-15567 IIT Research Inst., Chicago, Ill. Technology Center
PILOT EVALUATION OF VANADIUM ALLOYS Final Report, September 18, 1961–January 31, 1964
28 Jan. 1964 90 p refs
(Contract NOw 62-0101-c)
(IITRI-B231-10)

Experimental alloys based mainly on the vanadium–columbium system were fabricated to 0.050 in. sheet, which was generally workable and weldable. These alloys had density-corrected strengths superior to those of most columbium alloys up to 2,400° F. The strongest of the highly ductile compositions were based on V–60Cb with 1 to 10 w/o additions of reactive and refractory metals in combination with up to 0.1 w/o carbon. Consumable-electrode arc-melting under vacuum was used to prepare 100-lb ingots of three promising compositions. Extrusion followed by warm and cold rolling were used to produce 0.050-in.-thick sheet of V–20Cb–4Ti–1Zr–0.075C and V–60Cb–1Ti; the V–60Cb–1Zr–0.1C alloy broke up during extrusion. Silicide-coated specimens of V-60Cb-1Ti alloy were oxidation resistant in 2,000° and 2,400° F air for up to 160 hours. Somewhat reduced strength values, even on a density-corrected basis, were measured for V–20Cb–4Ti–1Zr–0.075C, and this alloy was less resistant to oxidation even in the silicide-coated condition. Author

N64-15573 General Dynamics, Fort Worth, Tex.
MATERIALS – 7075-T6 ALUMINUM ALLOY – CUMULATIVE DAMAGE EFFECTS – INVESTIGATION OF-
15 Jan. 1964 23 p refs
(Contract AF 33(657)-11214)
(FTDM-2892; AD-430152)

The S-N curves and the results of various multiple loadings on individual specimens from a single plate of 7075-T6 are presented as empirical data for the evaluation of methods of cumulative fatigue damage assessment. Author

N64-15588 General Dynamics, Fort Worth, Tex.
PROCESSING – HYDROGEN EMBRITTLEMENT OF CADMIUM PLATED, ARTC PROJECT 6-61, NOTCH TENSILE SPECIMENS – SUSTAINED LOAD TESTING OF
W. M. Pratt and R. L. Jones 15 Jan. 1964 22 p
(Contract AF 33(657)-11214)
(ERR-FW-161; AD-429911)

Twenty round notch tensile specimens of AISI 4340, aircraft quality steel, which had been heat treated to 260 to 280 ksi, were furnished by Boeing. Ten of the specimens had been cadmium plated by Boeing using their BAC 5718 plating system. These specimens were baked to remove hydrogen after the plating operation. The other ten specimens, which had been plated using the Dalic Brush system, were not baked. Hydrogen embrittlement was measured by sustain loading the notch tensile specimens at various stress levels and recording the time to failure. A lower critical stress level was established as the highest stress to which the specimens could be loaded without failure occurring within 100 hrs. The specimens plated and baked by Boeing gave a considerable spread of time to failure at the lower critical stress level obtained. The Dalic Brush plated specimens were more erratic. Author

N64-15594 Aerospace Corp., El Segundo, Calif. Materials Sciences Lab.
METALS AND ALLOYS FOR CRYOGENIC APPLICATIONS-A REVIEW
E. G. Kendall 20 Jan. 1964 68 p refs
(Contract AF 04(695)-269)
(SSD-63-271; TDR-269(4240-10)-6; AD-429244)

An up-to-date review of metals and alloys suitable for cryogenic aerospace structural applications has been made. The mechanical properties of austenitic stainless steels, other steels, aluminum alloys, titanium alloys, nickel alloys, and cobalt alloys from +78° to −423° F are presented, including tensile and yield strengths, elongation, and notch/tensile ratios. Mechanical properties of weldments are also presented. The question of notch toughness and the notch acuity factor, K_t, is discussed with respect to low-temperature tensile testing. Compatibility with the liquid gases is discussed, and alloys most suitable for containing liquid oxygen and hydrogen in aerospace vehicles are recommended. Author

N64-15597 Solar, San Diego, Calif.
EVALUATION OF COATED REFRACTORY METAL FOILS Quarterly Progress Report no. 6, 1 October–31 December 1963
V. S. Moore and A. R. Stetson 20 Jan. 1964 106 p refs
(Contract AF 33(657)-9443)
(RDR-1325-6; AD-429810)

Progress is reported in the following areas: (1) initiation of the multiple balance (MB) test program on coated columbium alloys; (2) diffusion studies of the Cr-Ti-Si and straight silicide coatings on CB752, B66, C129, and D43 alloys; (3) the investigation of nondestructive techniques of quality control applicable to the coated refractory metal foils; (4) a literature and industrial survey of coating repair processes and the development of several slurry repair coatings; (5) compatibility tests at 10^{-2} torr pressure on insulations, coated refractory foil, and superalloys. Author

N64-15603 United Kingdom Atomic Energy Authority, Harwell (Gt. Brit.) Atomic Energy Research Establishment
THE MECHANICAL PROPERTIES OF QUENCHED URANIUM MOLYBDENUM ALLOYS. PART II: A PRELIMINARY SURVEY OF THE DEFORMATION MECHANISMS
B. R. Butcher and B. A. Hatt (Fulmer Res. Inst.) 1963 48 p refs
(AERE-R-4353)

The deformation of compressed specimens of the martensitic α structures and the metastable γ phases of quenched uranium–molybdenum alloys containing 3 to 30 a/o molybdenum has been investigated by metallographic and X-ray means. The deformation characteristics of the α phases have helped in the qualitative understanding of the strengths shown by these phases. The true γ phase has been found to deform by {112} twinning, but one metastable γ phase deforms by {122} twinning, the twins themselves being twinned on {112} planes; another metastable γ phase also deforms by {122} twinning, but in this case the twins are themselves twinned on {112} planes. The various twinning phenomena are discussed in terms of the order thought to exist in the metastable phases. Author

N64-15666 Battelle Memorial Inst., Columbus, Ohio Defense Metals Information Center
HIGH-STRENGTH STEELS Review of Recent Developments, Oct. 15, 1963–Jan. 15, 1964
H. J. Hucek 31 Jan. 1964 2 p refs

This brief review of new developments in the technology of high-strength steels covers the following areas: (1) ultra-high-strength bainite, (2) shear spinning of maraging steels, and (3) kinetics and mechanisms of the strengthening of maraging steels. R.T.K.

N64-15675 Joint Publications Research Service, Washington, D.C.

WELDING NICKEL AND ITS ALLOYS

K. V. Bagryanskiy and G. S. Kuz'min 28 Jan. 1964 169 p refs Transl. into ENGLISH of a book "Svarka Nikelya i Yego Splavov", Moscow, Mahgiz, 1963 p 1–164

(JPRS-22945; OTS-64-21415) OTS: $3.00

This book presents basic information on the properties of nickel and certain of its alloys. The most important physicochemical processes and structural changes that occur during the welding of these metals are considered. The construction peculiarities of welded joints of nickel are described. Data are cited on the presently used materials for the welding of nickel articles—compositions of welding wires, electrode coatings, fluxes, etc. The technology of the existing methods of manual and mechanized welding is considered, and the available domestic experience in the preparation of chemical apparatus from nickel and its alloys is generalized. Author

N64-15709 Battelle Memorial Inst., Columbus, Ohio Defense Metals Information Center

A DISCUSSION OF THE PHYSICAL METALLURGY OF THE 18 PER CENT NICKEL MARGING STEELS

A. M. Hall 15 Nov. 1963 24 p refs

(Contract AF 33(615)-1121)

(DMIC-194; AD-430082)

Various aspects of the physical metallurgy of the 18% nickel marging steels are discussed. Some comparisons and analogies are drawn among various members of the martensitic steels family, with particular reference to the 18% nickel steels. The phase relationships and their features, which control the behavior of these steels, are dictated largely by the thermodynamics of the binary iron–nickel system. In these steels, the product of austenite transformation is a martensite that has an essentially body-centered cubic structure. The austenite–martensite reaction is accomplished by a reversible shearing process. On heating for extended periods at the higher aging temperatures, or for shorter times at temperatures between the aging range and the annealing range, the martensite tends to revert to austenite. Author

N64-15718 Oak Ridge National Lab., Tenn.

EFFECT OF HEAT FLUX ON THE CORROSION OF ALUMINUM BY WATER. PART IV: TESTS RELATIVE TO THE ADVANCED TEST REACTOR AND CORRELATION WITH PREVIOUS RESULTS

J. C. Griess, H. C. Savage, and J. L. English Feb. 1964 37 p refs

(Contract W-7405-eng-26)

(ORNL-3541) OTS: $1.00

The rate of corrosion of 6061 and X-8001 aluminum alloys, and the formation of an adherent corrosion product on the corroding surface were investigated under conditions comparable to those (excepting that of radiation) that will exist on the surface of fuel-element cladding during operation of the Advanced Test Reactor. The coating films have low thermal conductivity, and can be a major factor in producing high fuel-element temperatures that lead to fuel-plate instabilities. The rate of oxide formation on the specimens decreased with exposure time and increased as the surface temperature increased. The results of the experimental program indicate that the 6061 aluminum alloy, which has mechanical strength superior to either 1100 (used in an earlier study) or X-8001, will have adequate corrosion resistance for use as cladding for both the Advanced Test Reactor and the High Flux Isotope Reactor fuel plates, provided the pH of the water is maintained at 5.0 with nitric acid. However, the increase in fuel-plate temperatures resulting from the buildup of the corrosion-product layer must be evaluated carefully to determine its effect on the mechanical and irradiation behavior of individual fuel plates and on the overall fuel-element stability. R.L.K.

N64-15756 Westinghouse Electric Corp., Blairsville, Pa. Materials Mfg. Div.

PROCESSING AND EVALUATION OF PRE-PRODUCTION QUANTITIES OF COLUMBIUM ALLOY SHEET Final Report, 24 Jan. 1963–15 Jan. 1964

R. A. Nadler 20 Jan. 1964 62 p ref

(Contract N600(19)-59546)

(AD-430003)

Single 300-pound, 6-in.-diam ingots of FS-85 (Cb–27Ta–10W–1Zr) and B-66 (Cb–5Mo–5V–1Zr) were converted to 0.050-in. by 18-in.-wide sheet and evaluated with respect to mechanical properties and weldability. The yields from ingot to sheet were 46% for B-66 and 50% for FS-85. FS-85 was judged to be the more fabricable alloy; this was attributed to its lower strength. The quality of the sheet produced was equivalent for the two alloys, except that better flatness was achieved for FS-85. The tensile strength and stress-rupture behavior of B-66 was superior to that of FS-85 up to 2,400° F, the highest testing temperature. This superiority is greatly magnified when comparisons are made on a strength–density basis, since FS-85 is 25% more dense than B-66. Base metal bendability was less than 1T for both alloys. FS-85 had 4T bend transition temperature of −250° F as compared to −100° F for B-66. The as-welded ductility of FS-85 was superior to that of B-66, although welds of the latter alloy had good ductility at room temperature for the high strengths exhibited by the alloy. Author

N64-15770 Joint Publications Research Service, Washington, D.C.

EFFECT OF INDIVIDUAL FEATURES OF THE TECHNOLOGICAL PROCESS ON THE PROPERTIES OF REFRACTORY METAL CASTINGS

E. Ya. Kukkonen et al 4 Feb. 1964 9 p refs Transl. into ENGLISH of an article from Mekh. Svoystva Litogo Metalla (Moscow), 1963 p 223

(JPRS-23064; OTS-64-21479) OTS: $0.50

The effect of the method of preparation of the liquid metal, melting conditions, casting parameters, etc., on the properties of metal castings made from titanium-and molybdenum-based alloys was investigated. R.T.K.

N64-15819 Naval Air Engineering Center, Philadelphia, Pa. Aeronautical Materials Lab.

INVESTIGATION OF SPOT WELDING CHARACTERISTICS OF TITANIUM ALLOYS Ti-5Al-5Zr-5Sn, Ti-7Al-12Zr, AND Ti-8Al-1Mo-1V

Edward J. Fogarty 20 Nov. 1963 30 p refs

(NAEC-AML-1815; AD-424204)

A study of the resistance welding characteristics of titanium alloys Ti-5Al-5Zr-5Sn, Ti-7Al-12Zr, and Ti-8Al-1Mo-1V are reported. Optimum weld schedules were developed for three gage thicknesses of each alloy through a systematic variation of welding parameters. No difficulty was encountered in resistance welding these alloys. Each alloy could be spot welded using a wide range of machine settings without encountering internal weld quality problems. Data are presented on the room and elevated temperature strength of spot welded joints for each thickness of each alloy. Data are also presented on the thermal stability characteristics and the fatigue strength of spot welded joints in each alloy. Author

N64-15821 Stanford Research Inst., Menlo Park, Calif. Calif.
TUNGSTEN AND ROCKET MOTORS Final Report
G. M. Gordon and D. A. Brown 31 Dec. 1963 72 p refs
(Contract NOrd-18619(FBM))

The erosion and thermal shock characteristics of tungsten were studied under conditions that simulated the exhaust of an aluminized rocket propellant. The erosion research consisted of two phases: a static chemical reaction study, and a dynamic erosion study employing a plasma torch. For the conditions studied, it was found that H_2, N_2, HCL, and Al_2O_3 caused only negligible erosion when reacted with tungsten, whereas moderate to severe erosion was noted for CO_2, H_2O, and HCL + Al_2O_3. The thermal shock study employed a specially constructed test apparatus (using hollow cylindrical specimens) to experimentally characterize the relative resistance of various types of tungsten. Of the materials studied, silver- and copper-infiltrated tungsten had the best thermal shock resistance, and 80% dense pressed and sintered tungsten had the poorest. Author

N64-15837 Hanford Atomic Products Operation, Richland, Wash. Reactor and Fuels Lab.
MICROFRACTOGRAPHY OF ALPHA PLUTONIUM – REPLICA TECHNIQUES
G. E. Miller, T. K. Bierlein, and B. Mastel Dec. 1963 15 p refs
(Contract AT(45-1)-1350)
(HW-79846)

Electron microfractography has been utilized to characterize the fracture modes of deformation of unalloyed alpha plutonium over the temperature range −196° to 100° C. It has been found that the fracture mode at −196° C is entirely by intercrystalline separation. At the higher temperatures, the fracture mode is primarily by transgranular cleavage with some evidence of ductile shear. Author

N64-15838 Bureau of Mines, Albany, Ore. Metallurgy Research Center
METALLURGICAL QUARTERLY PROGRESS REPORT, PERIOD OF OCTOBER 1 THROUGH DECEMBER 31, 1963
A. H. Roberson [1963] 32 p refs
(Contract AT(11-1)-599)
(USBM-U-1091; Rept. 21)

This report concerns rare-earth alloy development, determination of the physical and mechanical properties of hafnium carbide, investigation of thorium alloy systems, electron-beam and cold-mold induction melting, uranium nitride melting and casting, the thermodynamics of cold-mold arc melting, and tungsten–rhenium tubing development. C.L.W.

N64-15935 Metals and Controls, Inc., Attleboro, Mass.
STUDY OF DUCTILE COATINGS FOR THE OXIDATION PROTECTION OF COLUMBIUM & MOLYBDENUM ALLOYS Third Bimonthly Progress Report, 1 Nov.- 31 Dec. 1963
31 Jan. 1964 13 p refs
(Contract NOw 63-0706-c)
(AD-429754)

Additional oxidation tests were performed on platinum and platinum–10% rhodium alloy at temperatures up to 1,525° C. The effect of airflow rate on oxidation rate was studied at 1,200° C (2,200° F) and 1,400° C (2,550° F). Also, the rate of oxidation of platinum at 1,525° C (2,800° F) was determined in an airflow of 24 ipm. Binary composites of platinum on columbium and molybdenum were prepared and tested. The methods used in sample preparation did not provide sufficient edge protection, and several new methods are being considered. Methods were selected for preparation of coating–diffusion barrier–base metal composites. An attempt was made to form an alumina diffusion barrier on FS-85 alloy through the reaction of aluminum foil with oxide on the surface of the alloy. The film formed was not satisfactory. Author

N64-15968* National Aeronautics and Space Administration, Washington, D.C.
DETERIORATION OF SOME ALUMINUM ALLOYS IN THE PRESENCE OF MERCURY AND CESIUM
William Rostoker (IIT Res. Inst.) Mar. 1964 18 p ref
(NASA Contract NAS3-2251)
(NASA CR-30; ARF-R3501-B41) OTS: $0.50

The possibilities of embrittlement and corrosive attack on Al 1100-O and 5083-O alloys have been explored. It is shown that no serious hazard exists if the 5083-O alloy as the load-bearing portion of the structure is clad with a thick surface of 1100-O alloy. It is also shown that no advantage accrues from the use of 5052-O and 5454-O alloys as a substitute for 5083-O. Some preliminary tests of Hg or Li embrittlement of austenitic stainless steel show that no hazard exists. From this viewpoint it may be regarded as a suitable cladding for 5083-O alloy. Author

N64-15979 Lockheed Missiles and Space Co., Sunnyvale, Calif.
IRON PLATING: AN ANNOTATED BIBLIOGRAPHY [1940-JUN. 1963]
Jack B. Goldmann, comp. Jul. 1963 95 p refs
(Contract NOw-62-0363)
(SB-63-55; Rept. 3-26-63-5)

This annotated bibliography covers mainly the electroplating of iron, and of the alloy, iron–nickel. Also, production methods for the deposition of heavy layers of iron and iron-nickel on stainless steel were emphasized. Printed sources were examined for the years 1940 through June 1963. Author

N64-16069 Stanford Research Inst., Menlo Park, Calif.
HIGH TEMPERATURE OXIDATION AND NITRIDATION OF NIOBIUM IN ULTRAHIGH VACUUM Interim Report, June 1, 1962–July 1, 1963
R. A. Pasternak Washington, AEC Div. of Tech. Inform., 15 Feb. 1964 53 p refs
(Contract AT(04-3)-115)
(TID-19489) OTS: $1.25

New techniques and methods have been developed for the study of sorption mechanisms and gas–metal equilibria at very low pressures and over a wide range of temperatures. A theoretical treatment of possible sorption mechanisms has been carried out. The sorption of nitrogen by three niobium samples has been studied over a wide temperature and pressure range. Sorption by two of the samples showed the same pattern: formation of a monolayer at room temperature; growth of a nitride layer at intermediate temperatures; and, at high temperatures, solution of nitrogen in the metal at a rate that is independent of time t and temperature T but proportional to pressure p. Some sorption data were obtained with the third sample for nitrogen and for oxygen. This sample showed very little activity for nitrogen; it is suspected that surface and/or bulk contamination of an unknown nature are responsible. Author

19 MATERIALS, NONMETALLIC

Includes mechanical and physical properties of nonmetals (e.g., plastics). *For related information see*: 07 Chemistry; 17 Machine Elements and Processes; 18 Materials, Metallic; 33 Stresses and Loads; and 34 Structural Design.

N64-15020 Bundesministerium fur Verkehr, Bonn (W. Germany)

BONDED SOLID- AND LAMINATED-WOODS: BEHAVIOR UNDER EXTREME CLIMATIC CONDITIONS AND NONDESTRUCTIVE TESTING [VERLEIMTE VOLL- UND LAGENHOLZER: VERHALTEN UNTER EXTREMEN KLIMABEDINGUNGEN UND ZERSTORUNGSFEIE PRUFUNG]

K. Egner, H. Bruning, and H. Kolb (Tech. Hochschul Stuttgart) Dusseldorf, VDI-Verlag GmbH, 1963 29 p refs in GERMAN

(Its Luftfahrt-Forschungsberichte 20)

This report, concerning wood for aircraft, contains the following articles: (1) "Tests of Standard Adhesives for Acid Damage and Embrittlement of Straight-Glued Joints in the Case of Solid Wood under Extreme Climatic Conditions"; (2) "The Behavior of Laminated Woods under Extreme Climatic Conditions"; and (3) "The Possibility of Recognizing Wood and Adhesive Defects and Damages by Nondestructive Testing." I.v.L.

N64-15068 State U. of New York at Buffalo Carbon Research Lab.

INVESTIGATION OF ELASTIC AND THERMAL PROPERTIES OF CARBON-BASE BODIES Technical Report, Feb. 1962-Aug. 1963

S. Mrozowski, J. F. Andrew, N. Juul, S. Sato, H. E. Strauss et al Wright-Patterson AFB, Ohio, AF Mater. Lab., Oct. 1963 77 p refs

(Contract AF (616)-7791)

(WADC-TR-58-360, Pt. 5; AD-427104)

Using greatly improved high-temperature equipment, curves of the dependence of Young's modulus on temperature and on heat treatment have been obtained for four basic types of carbons and, as far as possible, for a number of special types of commercial carbons. The amplitude dependence of internal friction and dynamic Young's modulus were investigated in the sonic range for a number of types of carbons, as well as the temperature dependence of internal friction of the resonance frequency from room temperature to liquid hydrogen temperature. A Bordoni peak at 50°K has been found to be connected with the relaxation of motion of dislocations. Curves of the dependence of heat conductivity and electric resistivity on temperature and on heat treatment have been obtained for four basic types of carbons. The "steady" sinusoidal wave technique for determination of heat diffusivity has been improved in precision and extended in temperature range.

Author

N64-15069 Union Carbide Corp., Lawrenceburg, Tenn. Advanced Materials Lab.

RESEARCH AND DEVELOPMENT ON ADVANCED GRAPHITE MATERIALS. VOLUME XXII: PHOTOMICROGRAPHIC TECHNIQUES FOR CARBON AND GRAPHITE Technical Documentary Report, 1 May 1960-30 Nov. 1962

G. L. Peters and H. D. Shade Wright-Patterson AFB, Ohio, Directorate of Mater. and Processes, Nov. 1963 44 p refs

(Contract AF 33(616)-6915)

(WADD-TR-61-72, vol. 22; AD-427177)

Photomicrography has allowed identification of various materials, such as cokes, graphites, pitch, etc., within the formed article and has permitted a study of the distribution of these materials. The effect of impregnation of the graphite with pitches and resins can be more clearly defined by careful photomicrographic examination. Standard metallographic equipment can be used for such studies, but preparation of the carbon and graphite requires special techniques. Mounting methods to prevent smearing or chipping of the samples during preparation and to obtain very highly polished surfaces are discussed. Also described are various techniques of lighting to aid in revealing and interpreting microstructure, and the different types of photographic film, plates, developers, and printing papers required for showing pertinent details in the final photomicrograph. Author

N64-15070 National Carbon Co., Parma, Ohio Research Lab.

RESEARCH AND DEVELOPMENT ON ADVANCED GRAPHITE MATERIALS. VOLUME XXIV: THE THERMAL EXPANSION OF GRAPHITE IN THE C_o-DIRECTION

C. E. Lowell Wright-Patterson AFB, Ohio, AF Mater. Lab., Nov. 1963 20 p refs

(Contract AF 33(616)-6915)

(WADD-TR-61-72, Vol. 24; AD-427185)

The thermal expansions of lampblack-base, coke-base, hot-worked coke-base, and pyrolytic graphites have been measured in the c_o direction from 1,000° to 2,700°K by use of a high-temperature X-ray camera. The results indicate that the coefficient of thermal expansion is not constant with temperature and that this coefficient increases with increasing crystallite perfection. The camera was modified to accept a low-temperature attachment, and the a_o's and c_o's of lampblack-base, hot-worked coke-base, and pyrolytic graphites were evaluated at 6°, 78°, and 298°K. The three graphites showed similar expansion characteristics and, within the limits of error, seemed to show a negative a_o expansion coefficient near 298°K. Author

N64-15100 ManLabs., Inc., Cambridge, Mass.

INVESTIGATION OF BORIDE COMPOUNDS FOR VERY HIGH TEMPERATURE APPLICATIONS Technical Documentary Report, Apr. 1962-Sep. 1963

Larry Kaufman and Edward V. Clougherty Wright-Patterson AFB, Ohio, AF Mater. Lab., Dec. 1963 391 p refs

(Contract AF 33(657)-8635)

(RTD-TDR-63-4096, Pt. 1; AD-428006)

A comprehensive study of the properties of high-purity well-characterized samples of TiB_2, ZrB_2, HfB_2, and TaB_2 has been performed. The sintering mechanism of TiB_2 was investigated. Powder purification procedures by acid leaching and vacuum heating were examined. Properties measured included lattice parameter, X-ray thermal expansion, linear thermal expansion, electrical resistivity, and microhardness. Measurements were generally performed between room temperature and 1000°C. Phase boundary experiments were performed in a Zr–B system, and the current status of the phase diagrams of these materials was reviewed. Kinetic studies were performed to elucidate the mechanism of oxidation and to study the nature of protective coatings that are produced by some of the materials in oxidizing atmospheres. An integrated thermodynamic analysis of the diborides was completed. On the basis of current vapor pressure and oxidation data, HfB_2 and ZrB_2 are shown to be the most likely candidates for high-temperature applications requiring oxidation resistance. Author

N64-15109 Naval Ordnance Test Station, China Lake, Calif.
CALOROBIC INORGANIC-ORGANIC POLYMERS
R. J. Landry and E. H. Bartel In ONR Solution to Navy Probl. through Advanced Technol. [1963] p 117–128 refs (See N64-15101 07-01) OTS: $5.00

Research was directed primarily toward optimizing the preparation procedures and end-use of the zirconium (IV) phenoxyaldehyde polymer. A novolac (prepolymer) of hafnium (IV) phenoxyaldehyde and impure vanadium (IV) phenoxyaldehyde was prepared. Aldehydes, other than paraformaldehyde, and aromatic alcohols, other than phenol, were evaluated. A study was conducted in order to obtain, as a pyrolytic product, the carbide composition 4TaC + HfC, which has one of the highest melting points (7619° F) of any known material. R.T.K.

N64-15110 Naval Research Lab., Washington, D.C.
PHYSICAL PROPERTIES OF THE PALLADIUM-HYDROGEN SYSTEM
A. I. Schindler In ONR Solution to Navy Probl. through Advanced Technol. [1963] p 129–148 refs (See N64-15101 07-01) OTS: $5.00

Measurements of the electrical resistivity, thermoelectric power, and lattice parameter of palladium were made, as a function of temperature, after charging it with hydrogen and also following desorption. The temperature dependence of the neutron scattering of palladium containing absorbed hydrogen and deuterium was also examined. R.T.K.

N64-15158 Bureau of Mines, Berkeley, Calif. Berkeley Thermodynamics Lab.
LOW-TEMPERATURE HEAT CAPACITIES AND ENTROPIES AT 298.15°K OF LEAD MOLYBDATE AND LEAD TUNGSTATE
William W. Weller and K. K. Kelley 1964 9 p refs
(BM-RI-6357)

Heat capacity measurements of lead molybdate and lead tungstate were conducted over the temperature range from 51° to 298° K. The entropies were found to be $S^{\circ}_{298.15} = 39.7 \pm 0.5$ cal/deg mole for lead molybdate and $S^{\circ}_{298.15} = 40.2 \pm 0.5$ cal/deg mole for lead tungstate. The entropy values were combined with other pertinent data to obtain the entropies of formation of the two compounds from their constituent elements and oxides. Author

N64-15224 Argonne National Lab., Ill.
COMPOUNDS IN THE BINARY PHASE DIAGRAMS OF THE MONOVALENT CHLORIDES WITH THE MULTIVALENT CHLORIDES
R. Gut, E. Iberson, and D. M. Gruen Nov. 1963 23 p refs
(Contract W-31-109-eng-38)
(ANL-6803)

The phase-diagram literature was surveyed to the end of 1960. Information about the binary systems of monovalent with multivalent chlorides was observed. Compounds of double chlorides occuring in these systems are listed in tabular form together with the available structural information. Author

N64-15233* Synthetic Fluids Service, Inc., Pacific Palisades, Calif.
LIQUID LUBRICANTS
Douglas H. Moreton *In* NASA, Lewis Res. Center Advanced Bearing Technol. 1964 p 175–201 refs (See N64-15226 07-01) GPO: $1.75

The evolution and development of lubricants is considered in terms of the demanding requirements for liquid lubricants used in aircraft and in space projects. Some important properties are discussed that affect the performance and lifetime of lubricants. These properties are: oxidation, viscosity, thermal stability, volatility, flammability, and hydrolytic stability. C.L.W.

N64-15234* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio
NONCONVENTIONAL LUBRICANTS
Edmond E. Bission *In its* Advanced Bearing Technol. 1964 p 203–257 refs (See N64-15226 07-01) GPO: $1.75

Consideration is given to nonconventional lubricants, such as solids or gases, for operation at high temperatures. The requirements for solid lubricants are discussed; the role of such lubricants in the reduction of friction and wear in operating mechanisms, and the method of application of these lubricants are included.The use of gases containing reactive atoms in the molecule is examined. The problem areas arising from use of reactive gases as lubricants are explored, and some of the solutions to these problems are indicated. C.L.W.

N64-15359 Lockheed Missiles and Space Co., Palo Alto, Calif. Metallurgy and Ceramics Lab.
BERYLLIUM-RICH END OF FIVE BINARY SYSTEMS
M. I. Jacobson and M. L. Hammond 31 Dec. 1963 38 p refs
(Contract AF 33(657)-11225)
(Rept. 2-53-64-1; AD-428766)

The work of previous investigators on the binary systems of beryllium with aluminum, silver, copper, chromium, and iron is described. The basic method to be used for determining the diagrams for this study is the analysis of diffusion couples. Comparisons are made between the X-ray and the electron-beam microprobe method of analyzing the diffusion couples. A brief description of the attempts to zone refine 1/2-in.-diam. beryllium bars is presented. Author

N64-15533* National Beryllia Corp., Haskell, N.J.
RESEARCH ON LOW DENSITY THERMAL INSULATION MATERIALS FOR USE ABOVE 3000°F Sixth Quarterly Status Report, 1 Jul.-30 Sep. 1963
K. H. Styhr [1963] 32 p refs
(NASA Contract NASr-99)
(NASA CR-55559) OTS: $3.60 ph, $1.16 mf

The concept of the reduction of the radiation or photon transfer of heat through the pores of a low-density ceramic structure at high temperature by the incorporation of various radiation-barrier phases into these voids is being investigated. The radial heat-flow thermal-conductivity metering apparatus has been modified from a graphite helix to a graphite hairpin heater design, simplifying specimen changing and temperature measurement. Thermal-conductivity data up to specimen hot-face temperatures of 4,235° F are reported for zirconia foam samples. Descriptions and photomicrographs of ceramic foams containing metallic thermal-radiation-reflecting phases are presented. Preliminary data on graphite radiation-scattering phases are included. A reprint of a technical paper describing the thermal-conductivity test cell is appended. Author

N64-15539* California U., Los Angeles
SEMI-ANNUAL STATUS REPORT FOR THE PERIOD JUNE 1, 1963-NOVEMBER 30, 1963 ON INVESTIGATION OF CERAMICS AS STRUCTURAL MATERIALS
F. R. Shanley, W. J. Knapp, R. D. Chipman, M. A. Ali, George Nikolaychik, and David Weiss Nov. 1963 17 p refs
(NASA Grant NsG-427)
(NASA CR-55661; Rept. 63-59) OTS: $1.60 ph, $0.80 mf

Prior research, aimed at the successful use of ceramics as structural materials, and mainly utilizing the technique of prestressing, is reviewed. The objectives of the present research program are presented. Current investigations are concerned with the strength of cellulated ceramics, the effects of uniaxial and biaxial prestressing, the load-deflection characteristics of a prestressed ceramic slab, and the fabrication of a prestressed ceramic dome. Author

N64-15561 Mallinckrodt Chemical Works, Weldon Spring, Mo. Uranium Div.
PROCESS DEVELOPMENT QUARTERLY PROGRESS REPORT, JULY-SEPTEMBER 1963
J. H. Yeager et al 1 Nov. 1963 49 p refs
(Contract W-14-108-Eng-8)
(MCW-1482) OTS: $1.00

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2. THE DETERMINATION OF OXYGEN IN FUSED FLUORIDE ELECTROLYTES BY VACUUM FUSION USING MASS SPECTROMETRIC MEASUREMENT L. G. Lueders and H. F. Waldron p 11–18 refs
3. DETERMINATION OF THE PHASE DIAGRAM FOR THE SYSTEM U-A1-Fe WITH AN ELECTRON MICROPROBE L. A. Fergason and N. F. Neumann p 19–26 refs
4. ANALYSIS OF URANIUM ALLOYS WITH THE ELECTRON MICROPROBE L. A. Fergason and D. L. Parker p 27–35 refs
5. A GENERAL METHOD FOR THE DETERMINATION OF TRACE ELEMENTS IN HIGH-PURITY MAGNESIUM METAL J. R. Nelms and R. S. Vogel p 37–46 refs

N64-15576 Union Carbide Corp., Parma, Ohio
RESEARCH AND DEVELOPMENT ON ADVANCED GRAPHITE MATERIALS, VOLUME XIX– THERMAL STRESSES IN ANISOTROPIC HOLLOW CYLINDERS
Tu-Lung Weng Wright-Patterson AFB, Ohio. AF Mater. Lab., Dec. 1963 47 p refs
(Contract AF 33(616)-6915)
(WADD-TR-61-72, Vol. 19; AD-427734)

The equations of thermal stresses and displacements in anisotropic hollow cylinders subjected to various arbitrary temperature boundary conditions have been derived. The hollow cylinder is assumed to be made of transversely isotropic material. Several numerical examples are treated, and the effects of the degree of anisotropy on the magnitudes of the critical stress and maximum permissible gas temperature for various sizes of grade ATJ and grade ZTA graphite hollow cylinders are examined. The errors that could result from the assumption of isotropic material are calculated. Author

N64-15577 Union Carbide Corp., Parma, Ohio
RESEARCH AND DEVELOPMENT ON ADVANCED GRAPHITE MATERIALS, VOLUME XX– THE ELECTRIC AND MAGNETIC PROPERTIES OF PYROLYTIC GRAPHITE
G. Wagoner and B. H. Eckstein Wright-Patterson AFB, Ohio. AF Mater. Lab., Nov. 1963 27 p refs
(Contract AF 33(616)-6915)
(WADD-TR-61-72, Vol. 20; AD-426185)

This paper discusses the electric and magnetic properties of a series of highly turbostratic pyrolytic graphite deposits. The diamagnetic susceptibility, Hall coefficient, and electron spin resonance g value are observed to have much larger magnitudes than corresponding measurements made on single crystals of graphite. The results are interpreted as being due to the turbostratic character of the deposit, which brings about a decreased interaction between the randomly rotated graphitic planes. The overlap of the electron and hole bands is thereby reduced and as a first approximation the results can be interpreted using the simple two-dimensional model of Wallace. McClure's diamagnetism formula, which is based on the Wallace model, yields a maximum trace value of −39 emu/g. The largest observed value is −33.5 emu/g, a diamagnetism almost 50 percent greater than the normal single crystal value of −22.8 emu/g. Author

N64-15578 Union Carbide Corp., Parma, Ohio
RESEARCH AND DEVELOPMENT ON ADVANCED GRAPHITE MATERIALS, VOLUME XXI– CARBON ARC IMAGE FURNACE STUDIES OF GRAPHITE
M. R. Null and W. W. Lozier Wright-Patterson AFB, Ohio. AF Mater. Lab., Nov. 1963 59 p refs
(Contract AF 33(616)-6915)
(WADD-TR-61-72, Vol. 21; AD-426665)

Measurements obtained using a carbon arc image furnace indicate that the spectral reflectance and emissivity of carbon and graphite samples in the visible region of the spectrum are strongly dependent on surface finish, but are independent of temperature to at least 3,000° K, regardless of surface finish. Discrepancies with other measurements of emissivity are indicated to be caused by errors in the measurement of surface temperature, due to thermal gradients. Information has been obtained with the carbon arc image furnace indicating that the thermal conductivity of surface material depends strongly on surface finish and is smaller than the conductivity of substrate material. Author

N64-15579 National Carbon Co., Parma, Ohio
RESEARCH AND DEVELOPMENT ON ADVANCED GRAPHITE MATERIALS. VOLUME XXVII – CARBONIZATION STUDIES OF POLYNUCLEAR AROMATIC HYDROCARBONS
I. C. Lewis and T. Edstrom Wright-Patterson AFB, Ohio. AF Mater. Lab., Nov. 1963 37 p refs
(Contract AF 33(616)-6915)
(WADD-TR-61-72, Vol. 27; AD-427129)

The variation of graphite properties with chemical structure is illustrated for synthetic graphites prepared from 35 pure aromatic compounds. Detailed chemical and physical studies have been directed to the carbonization of two model aromatic hydrocarbons, acenaphthylene and 9,9'-bifluorenyl. These compounds exhibit extremes in graphitization behavior, and the chemical reaction mechanisms are found to be consistent with the nature of the final graphite products. Carbonization studies have been extended to the effects of aromatic quinone additives on the carbonization behavior of polynuclear aromatic hydrocarbons. Quinones are shown to effect a general increase in coking value of the polynuclear aromatics and of complex aromatic mixtures. The mechanisms of these interactions are discussed. Author

N64-15580 National Carbon Co., Parma, Ohio
RESEARCH AND DEVELOPMENT ON ADVANCED GRAPHITE MATERIALS. VOLUME XXXIX – DIAMAGNETIC SUSCEPTIBILITY OF GRAPHITE BY THE FARADAY METHOD
D. E. Soule and C. W. Nezbeda Wright-Patterson AFB, Ohio. AF Mater. Lab., Nov. 1963 61 p refs
(Contract AF 33(616)-6915)
(WADD-TR-61-72, Vol. 39; AD-426781)

The diamagnetic susceptibility of several types of graphite, both single and polycrystalline, was investigated at room temperature by the Faraday method. For single crystals, the conduction electron component (|| c-axis) is $X_{\parallel} = -21.8 \times 10^{-6}$ emu/gm; whereas the isotropic ionic core component is $X_{\perp} = -0.32 \times 10^{-6}$ emu/gm, resulting in a maximum anisotropy ratio of 68. Anisotropies found for polycrystals range from 25 for annealed pyrolytic down to 1.01 for lampblack-base grade CEP graphite. The susceptibility trace, representing the contribution of the truly graphitic portion of a sample, ranges from -22.8×10^{-6} emu/gm for single crystals down to -19.1×10^{-6} emu/gm for grade ZTA graphite. Direct orientation measurements showed that both single crystals and polycrystals display a true cosine-squared dependence, modified in amplitude by the degree of preferred crystallite orientation. A study of the effect of annealing temperature up to 3,360° C on the anisotropy and trace of pyrolytic samples showed a competition of processes depending upon the properties of the "as-received" material. Author

N64-15581 National Carbon Co., Parma, Ohio
RESEARCH AND DEVELOPMENT ON ADVANCED GRAPHITE MATERIALS. VOLUME XLI – SURVEY AND ANALYTICAL REPRESENTATION OF THE MEASUREMENTS OF THE SPECIFIC HEAT OF GRAPHITE
G. B. Spence Wright-Patterson AFB, Ohio, AF Mater. Lab., Nov. 1963 52 p refs
(Contract AF 33(616)-6915)
(WADD-TR-61-72, Vol. 41; AD-427316)

A literature survey was made of the experimental values of the specific heat of graphite. Most of the measurements from 20° to 3,800° K were reanalyzed and a new average curve is given for each experimental run. Some of the new curves are significantly different from the original curves. Estimates are given of the $C_p - C_v$ term, the electronic specific heat, and the specific heat of the lattice vibrations. The lattice specific heat was approximated by various combinations of Einstein and one- and two-dimensional Debye functions. The characteristic temperatures were selected by a least-squares curve-fitting procedure. Author

N64-15585 Westinghouse Electric Corp., Pittsburgh, Pa. Westinghouse Research Labs.
A PULSED HYPERSONIC TECHNIQUE AND SOME ATTENUATION MEASUREMENTS IN QUARTZ AT LOW TEMPERATURES Scientific Report No. 4
J. de Klerk and D. I. Bolef 1 Nov. 1963 28 p refs
(Contract AF 19(604)-8826)
(AFCRL-63-564; AD-429179)

Conventional pulsed surface excitation of quartz in the kilomegacycle range of frequencies almost invariably produces nonexponentially decaying echo envelopes, making reliable attenuation measurements difficult. This difficulty can frequently be overcome by the use of conventional transducers and by careful bonding techniques. This transducer technique, methods of simultaneously generating compressional and shear modes in quartz, and a tunable cavity capable of being operated over a wide frequency range are described. Applications of this equipment to the measurement of attenuation of hypersound in single-crystal quartz as a function of transmitter power and of temperature below 20° K are briefly described. Author

N64-15606 Bureau of Mines, Albany, Ore. Metallurgy Research Center
VAPOR PRESSURE OF TUNGSTEN (VI) CHLORIDE AND HAFNIUM (IV) IODIDE BY A METAL DIAPHRAGM TECHNIQUE
F. D. Stevenson, C. E. Wicks, and F. E. Block 1964 36 p refs
(BM-RI-6367)

The vapor pressures of tungsten(VI) chloride (WCl_6) and hafnium(IV) iodide (HfI_4) were measured by a metal diaphragm technique. Vapor pressure values were obtained to permit calculation of the thermodynamic properties of the vaporization processes of the compounds. Author

N64-15650 Bureau of Mines, Berkeley, Calif. Berkeley Thermodynamics Lab.
HIGH-TEMPERATURE HEAT CONTENTS AND ENTROPIES OF ANDALUSITE, KYANITE, AND SILLIMANITE
Louis B. Pankratz and K. K. Kelley 1964 11 p refs
(BM-RI-6370)

Heat content measurements above 298.15° K were conducted for three crystalline varieties of Al_2SiO_5—andalusite (to 1,600° K), kyanite (to 1,500° K), and sillimanite (to 1,500° K). Measurements at higher temperatures were not possible because the substances decomposed to form mullite and cristobalite. The heat content results are given in both tabular and equation forms, and matching entropy increments were derived. A combination of entropy data with a free energy of formation value for mullite led to the conclusion that the heats of formation of andalusite, kyanite, and sillimanite from corundum and cristobalite at 1,600° K are less negative than −6.0 kcal/mole. Author

N64-15683 General Dynamics/Fort Worth, Tex. Fluid Dynamics Lab.
MECHANICAL-TIRE RUB STRIP – DETERMINATION OF WEAR CHARACTERISTICS
J. H. Martinez 15 Jan. 1964 28 p
(Contract AF 33(600)-38975; Contract AF 33(657)-11214)
(FGT-2735 Add.1; AD-429912)

Of materials tested to obtain a suitable backup insulator for the corrosion-resistant steel rub-strip face plate, glass-cloth phenolic laminates were found to be the most satisfactory. Tests indicate that the rub-strip pad should be fabricated of one piece of 0.020" × 6" × 7" corrosion-resistant steel and three pieces of 0.020" × 6" × 7" fiberglass laminates in a stacked position. This configuration will maintain a temperature of less than +220° F on the airframe skin. Methods are given for attaching the rub-strip to the airframe and to the landing gear door. The effective life of the rub-strip pad and insulator is adequate for at least 10 repetitive contacts by a tire without any deleterious effects. E.K.R.

N64-15699 United Kingdom Atomic Energy Authority, Harwell (Gt. Brit.)
THE EFFECT OF ANTISTATIC AGENTS ON FABRICS WOVEN FROM SYNTHETIC FIBRES
W. J. Colclough, A. J. Smith, and H. Wells Jul. 1963 17 p refs
(AERE-R-4254) HMSO: 2s 6d net

Laboratory and field evaluations of protective clothing made with staple polyester fiber suggest that appreciable savings can be made in replacements and overall laundry costs, e.g., washing schedules, drying, and finishing times. An intrinsic disadvantage of synthetic fibers is their tendency to develop static electrical charges. This report describes the evaluation, by surface resistivity measurements, of antistatic agents. The effect of antistatic treatments on subsequent radiological decontamination procedures was determined on samples of fabric contaminated with soluble and insoluble radioactive media. The report concludes that synthetic fibers

can be readily and efficiently treated to reduce their surface resistivity to an acceptable level, and that such treatment has no adverse effect upon the laundering process. Author

N64-15760 General Electric Co., Philadelphia, Pa. Missile and Space Div.
PYROLYTIC GRAPHITE, A STATUS REPORT
A. M. Garber, E. J. Nolan, and S. M. Scala Oct. 1963 62 p refs
(Contract AF 04(694)-222)
(R63SD84; AD-429731)

A thorough investigation of the properties of pyrolytic graphite is being carried out. Theoretical models are being developed so that its aerothermochemical and aerothermostructural behavior can be predicted with confidence for arbitrary hypersonic missions. In this paper, the currently available property data and analytical and numerical techniques are presented and discussed critically, and areas for future research and development are delineated. Author

N64-15762 Brown U., Providence, R. I. Metcalf Chemical Labs.
VISCOSITY OF HYDROGEN, DEUTERIUM, METHANE, AND CARBON MONOXIDE FROM −50°C TO 150°C BELOW 200 ATMOSPHERES
A. K. Barua, J. Ross, and M. Afzal Virginia U., Charlottesville, School of Eng. and Appl. Sci., Jan. 1964 21 p refs Submitted for Publication
(Contract Nonr-3623(00); Proj. Squid)
(BRN-10-P; AD-429502)

The absolute viscosities of H_2, D_2, CH_4, and CO have been determined from measurements in a capillary-flow viscometer in the temperature range from −50° to 150° C and at pressures below 200 atm with an average precision of 0.05%. The accuracy of the measurements, except for D_2, is estimated to be about 0.1%. The parameters (ϵ, γm, α) of the intermolecular exp-six potential have been estimated for H_2 and D_2 from the variation of the viscosity with temperature at low density. The size parameter γ_m is the same for the two systems, but ϵ is about 6% larger for H_2 than for D_2. Author

N64-15883* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
THERMOPOTENTIAL MEASUREMENTS FOR MOLTEN CADMIUM CHLORIDE, CADMIUM BROMIDE, AND LEAD CHLORIDE
Jacob Greenberg, Donald E. Weber, and Lawrence H. Thaller Repr. from J. Phys. Chem. v. 67, 1963 p 2488–2491 refs
(NASA RP-129)

In order to obtain some information concerning the possible use of molten salts as thermoelectric materials, the thermopotentials developed when molten $CdCl_2$, $CdBr_2$, and $PbCl_2$ are subjected to a thermal gradient were measured. These fused salts were pipetted into a Vycor U-tube, the two arms of which were heated to two different temperatures. The open-circuit voltage, which was recorded as a function of the temperature difference at the electrodes, was directly proportional to this temperature difference and appeared to be independent of the average temperature for the range and the temperature differences observed. It can be shown that the thermopotential is a function of the reduced heats of transfer and the transport numbers of the species involved. By using this relation, it is possible to estimate the entropy of transport for the salts. Author

N64-15916 College of Aeronautics, Cranfield (Gt. Brit.)
CHARACTERISTICS OF THE HIGH TEMPERATURE MECHANISMS OF CREEP AND RECOVERY IN GRAPHITE Quarterly Technical Status Report No.2, 1 Nov. 1963-31 Jan. 1964
Feb. 1964 5 p
(Contract DA-91-591-EUC-2880)
(COA-N-Mat. 1, Pt. 2)

Difficulties have been encountered on the tensile creep apparatus; these have been concerned with fracture of the specimen grips and with ignition of the gas escaping around the loading train. The hydraulic system of the torsional rig has been modified. The creep load is applied by a dead weight supported on a piston that compresses the hydraulic system. There is sufficient piston volume to accommodate the creep movement of the actuator and seepage losses for the normal duration of tests. A series of experiments have been carried out on ATJ graphite. The graphite was in plate form, and rods were cut and machined from it. The creep strain under a load of 2,000 psi shows the expected increase with temperature for a given loading time. Author

N64-15990 Bureau of Mines, Berkeley, Calif. Thermodynamics Lab.
HIGH-TEMPERATURE HEAT CONTENTS AND ENTROPIES OF MUSCOVITE AND DEHYDRATED MUSCOVITE
Louis B. Pankratz 1964 10 p refs
(BM-RI-6371)

Heat-content measurements were conducted for muscovite in the temperature range from 298° to 900° K, and for dehydrated muscovite in the temperature range from 298° to 1,200° K. Entropy values above 298.15° K were derived for both substances. The results are given in tabular and equation forms. The apparent heat content of the water in muscovite was extracted from the data and compared with similar information found previously regarding water in hydrated minerals. Author

N64-15991 Bureau of Mines, College Park, Md. Metallurgy Research Center
SOME PHYSICAL PROPERTIES OF CERIA POWDERS DERIVED FROM FIVE SALTS
Louis P. Domingues, Roy L. Wilfong, and LeRoy R. Furlong 1964 14 p refs
(BM-RI-6375)

The bulk and apparent densities, particle size, and surface area of ceria powders derived from the ammonium sulfate, carbonate, nitrate, oxalate, and sulfate salts and heated at 950° to 1,500° C for 1 to 24 hours were studied. The bulk and apparent densities and particle size generally increased, and surface area decreased, with increase in temperature and time of heating; surface area was more sensitive to changes in temperature and time than the other properties studied. The ammonium sulfate and sulfate salts heated at 950° and 1,200° C produced oxide powders with the lowest bulk density, the smallest particle size, and the highest surface area. The highest apparent densities were achieved for oxides resulting from the carbonate and the sulfate, but the carbonate-derived material was considerably coarser. The surface areas of ceria powders derived from cerium salts decrease in the order of sulfate, ammonium sulfate, nitrate, oxalate, and carbonate. The observation of these physical properties is useful in predicting the sintering behavior of various oxide powders. Author

N64-16016 Bureau of Mines, College Park, Md.
LINEAR CORRELATION OF MAGNETIC SUSCEPTIBILITY WITH THE CHEMICAL COMPOSITION OF MINERALS
Foster Fraas 1964 17 p refs
(BM-RI-6379)

Review of the literature on solid solutions discloses that the relation between composition and magnetic susceptibility is not linear. Recalculation using a transformation of composition values to parameter *v* values provides for a linear relation with the magnetic susceptibility to the 1/2 power. Application to minerals is illustrated by the olivine and enstentite series. Author

N64-16019 Massachusetts Inst. of Tech., Cambridge
ADAPTATION OF NEW RESEARCH TECHNIQUES TO MINERAL ENGINEERING PROBLEMS Annual Progress Report
A. M. Gaudin et al Washington, AEC Div. of Tech. Inform., 31 Oct. 1963 23 p refs
(Contract AT(30-1)-956)
(MITS-51; NYO-10330) OTS: $0.50

Areas of research are: an electrochemical study of the ferric oxide solution interface; contact angle hysteresis in the dodecane–water–quartz–amine system; adsorption in the hematite–water–diisobutyl ketone system, gas-phase conditioning for flotation of a nonmetallic ore; contact hysteresis in the dodecane–water–quartz–dodecyl ammonium chloride system; particle-size determination by combined centrifugation and gamma emission; mixed adsorption from the gaseous phase to ferric oxide; electrochemical study at the zinc oxide solution interface; beryl flotation; flotation of a phosphate ore from South Africa; hysteresis of contact angles on the system galena–aqueous potassium–ethyl xanthate–nitrogen; and the relationship between rheological properties and thickening mechanisms. C.L.W.

20 MATHEMATICS

Includes calculation methods and theory; computers; data processing; and numerical analysis. *For related information see*: 08 Communications; 09 Electronics; 10 Facilities, Research and Support; and 22 Navigation and Guidance.

N64-15033 Technische U., Berlin (W. Germany) Institut für Flugführung und Luftverkehr
EXAMPLES OF APPLICATION OF ANALOG COMPUTERS TO TRAJECTORY OPTIMIZATION [BEISPIELE DES EINSATZES VON ANALOGRECHNERN ZUR FLUGBAHNOPTIMALISIERUNG]
W. Giloi, E. Rossger, J. Wernicke, and H. Zehle Dec. 1963 54 p refs In GERMAN
(Rept. 28)

The following papers are presented: (1) "The Optimum Interplanetary Transfer Orbit with Variable Thrust"; (2) "The Optimum Combustion Time of a Vertical Ascending Rocket"; and (3)"The Optimum Interplanetary Transfer Orbit with Constant Thrust." Analog computers performed satisfactorily for each of the above-mentioned optimization studies. I.v.L.

N64-15099 Naval Postgraduate School, Monterey, Calif.
DISCONTINUOUS SYSTEM VARIABLES IN THE OPTIMUM CONTROL OF SECOND ORDER OSCILLATORY SYSTEMS WITH ZEROS
William B. Nevius and Harold Titus Jun. 1963 50 p refs
(Supported by ONR)
(*Its* Res. Paper 37; AD-429417)

This paper investigates the following problem: Given a second-order oscillatory system with one zero, find the optimum control for zeroing the errors in the system in minimum time and with minimum fuel. Pontryagin's maximum principle is used to solve the problem. It may be used to good advantage in the investigation of any n^{th}-order system with no more than n-1 zeros. The maximum principle provides a powerful tool in optimization, particularly for linear systems. The problem of controlling a plant with zeros is analagous to controlling a plant without zeros using an impulse-step-type controller. E.K.R.

N64-15170 North American Aviation, Inc., El Segundo, Calif.
AUTOMATED INFORMATION SYSTEMS IN PLANNING, CONTROL AND COMMAND
Andrew Vazsonyi Jun. 1963 83 p refs Presented at the 10th Intern. Meeting of Inst. of Management Sci., Tokyo, 21–24 Aug. [1963]

The status of automated information systems is reviewed, and a prognosis of changes that are likely to occur is presented. New techniques and devices that will bring about improved man–machine cooperation are explored, and illustrative case studies of On-Line-Real-Time Systems from both industrial and military fields are discussed. P.V.E.

N64-15179 Los Alamos Scientific Lab., N. Mex.
HUG, A FORTRAN–FAP CODE FOR COMPUTING NORMAL SHOCK AND DETONATION WAVE PARAMETERS IN GASES
Paul F. Bird, Russel E. Duff, and Garry L. Schott 4 Feb. 1964 71 p refs
(Contract W-7405-eng-36)
(LA-2980) OTS: $1.75

This computer code permits the solution of the Rankine-Hugoniot equations for normal shock waves in ideal gas mixtures for a large number of optional sets of conditions. The code has been written partly in FORTRAN II and partly in FAP, and is intended for use on the IBM 7090 or 7094 computers operating under the MONITOR system. Author

N64-15209* California U., Berkeley Lawrence Radiation Lab.
OPERATIONAL CALCULUS IN TWO VARIABLES
Aldo Rescigno *In its* Semiann. Rept.–Biol. and Med., Spring 1963 p 65–68 refs (See N64-15201 07-01) OTS: $2.75
(Supported by NASA and AEC)

An example is presented of the application of an algebra based on the two operations of addition and convolution. P.V.E.

N64-15245 Minneapolis-Honeywell Regulator Co., Minn. Military Products Group
QUESTIONS IN THE THEORY OF LIAPUNOV'S SECOND METHOD: THE CONSTRUCTION OF THE GENERAL SOLUTION IN THE DOMAIN OF ASYMPTOTIC STABILITY
V. I. Zubov [1962] 49 p refs Transl. into ENGLISH from Prik. Mat. i Mekh. (Moscow), v. 19, 1955 p 179–210
(MH-Transl. 389)

It is demonstrated that Liapunov's function satisfies a certain special equation in partial derivatives and exists in the entire domain of asymptotic stability of the undisturbed motion of a system of differential equations. A number of its properties are investigated; based on these properties it was possible to obtain the equation for the boundary of the domain of the asymptotic stability as well as the necessary and sufficient conditions for stability in general. Also presented is a general solution in the domain of asymptotic stability in the

form of series, converging either on the entire axis $(-\infty, +\infty)$ or on the semiaxis $(0, +\infty)$, or $(-\infty, 0)$. It is not required that all the roots of the defining equation have negative real parts. Author

N64-15272* Smithsonian Astrophysical Observatory, Cambridge, Mass.
ON THE LIBRATION ORBITS OF A PARTICLE NEAR THE TRIANGULAR POINT IN THE SEMIRESTRICTED THREE-BODY PROBLEM
G. Colombo, D. Lautman, and C. Munford Repr. from Astron. J., V. 68, no. 3, Apr. 1963 p 159–162 refs (See N63-12118 05-29)
(NASA Grant NsG-87-60)

This paper describes a numerical analysis of the motion of an infinitesimal body around the Lagrangian triangular point in the semirestricted three-body problem. The principal goal of the present research is the determination of the influence of the eccentricity of the moon's orbit on the small oscillations (librations) of the infinitesimal body around the triangular point. Author

N64-15313 Radio Corp. of America, Patrick AFB, Fla.
ERROR PROPAGATION
James N. Jamieson *In* AF Missile Test Center New Data Reduction Methods to Improve Range Data [1963] p 7–16 (See N64-15312 07-01)

The random errors known to exist in a measuring device are propagated through the mathematical model of the device to the final measurements, so that estimates of the errors in the data to be expected can be obtained when future measurements are taken. This is commonly referred to as geometric dilution of precision (GDOP). A description of the theory and the methods of computation are given. Author

N64-15319 Radio Corp. of America, Patrick AFB, Fla.
DATA SMOOTHING
J. R. Garrett and D. B. Gennery *In* AF Missile Test Center New Data Reduction Methods to Improve Range Data [1963] p 183–196 (See N64-15312 07-01)

A brief history of smoothing or filtering data is presented, and a type of filter in which the frequency response can be improved without increase in the timespan is described. Figures showing the actual frequency responses of the filter described with three different rolloff rates but with the same cutoff frequency are included for purposes of comparison. J.E.T.

N64-15322 Radio Corp. of America, Patrick AFB, Fla.
THE CYCLIC ERROR AS AN ATMOSPHERIC REFRACTION PHENOMENON
W. A. Dryden and O. J. W. Christ *In* AF Missile Test Center New Data Reduction Methods to Improve Range Data [1963] p 261–284 refs (See N64-15312 07-01)

Examples of the cyclic error in missile free-fall data collected by AZUSA MK II are discussed. A suggestion that anomalous atmospheric refraction is the source of this error is offered. In support of this suggestion, two possible causes are presented: (1) Turbulent mixing of the lower atmosphere can lead to differential refraction effects in a phase-comparison tracking system and can lead to temporal changes in the zero-set of the instrument. (2) A wave-like perturbation on the interface between two different-density layers of the atmosphere can lead to apparent cyclic deviations of a missile from a ballistic orbit. The effects of time variability of the index of refraction on the zero-set of AZUSA MK II are analyzed. A much simplified model of a sinusoidal wave on the interface of a two-layer atmosphere is also discussed with regard to its effect on a phase comparison tracking system. Author

N64-15326 Radio Corp. of America, Patrick AFB, Fla.
SOME NUMERICAL CHARACTERISTICS OF AN ERROR MODEL BEST ESTIMATE OF TRAJECTORY
D. H. Parks *In* AF Missile Test Center New Data Reduction Methods to Improve Range Data [1963] p 365–390 refs (See N64-15312 07-01)

Certain numerical characteristics that have exhibited themselves in the results from several simulated and real "Best Estimate of Trajectory" reductions are discussed. Emphasis has been placed upon the effects of various error model assumptions upon a BET. In addition, the effects of weighting the observations and of applying certain a priori knowledge to the solution are considered. Author

N64-15329* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
DIRECT REACTION CALCULATION
W. R. Gibbs (Los Alamos Nat'l. Lab.), V. A. Madsen, J. A. Miller (Texaco, Inc.), W. Tobocman (Case Inst. Technol.), E. C. Cox, and L. Mowry (IBM Corp.) Washington, NASA, Feb. 1964 46 p refs
(NASA TN D-2170) OTS: $1.25

This report presents the program called DRC. It is an automatic computer program in FORTRAN language for the calculation of transition amplitudes and cross sections on the basis of the distorted-wave Born approximation (DWBA). The incident- and the outgoing-channel wave functions used in the DWBA are descriptive of elastic scattering by an optical potential. DRC may be used to calculate the differential cross section for elastic scattering in both incident and outgoing channels. The following types of nuclear reactions can be treated by DRC: (1) inelastic scattering; (2) knockout; (3) projectile stripping; and (4) target stripping. Author

N64-15333 Joint Publications Research Service, Washington, D.C.
TEACHING MACHINES AND PROGRAMMED LEARNING IN THE SOVIET BLOC, A SURVEY OF THE PUBLISHED LITERATURE, 1962-1963
18 Feb. 1964 27 p refs
(JPRS-23280; OTS-64-21587) OTS: $0.75

The topics discussed are: Soviet conferences on programed instruction, simple teaching machines, computer-based teaching machines, programed instruction in the Soviet armed forces, programed learning without teaching machines, projected developments in Soviet programed instruction, and Soviet Bloc research on teaching machines and programed learning. R.T.K.

N64-15338 Oak Ridge National Lab., Tenn. Mathematics Div.
THE OAK RIDGE ALGOL COMPILER FOR THE CONTROL DATA CORPORATION 1604 – PRELIMINARY PROGRAMMER'S MANUAL
L. L. Bumgarner 30 Jan. 1964 48 p refs
(Contract W-7405-eng-26)
(ORNL-3460) OTS: $1.25

A knowledge of Algol 60 is assumed. Included are descriptions of input-output facilities and details for operation under the monitor system. Author

N64-15340 California U., Berkeley. Lawrence Radiation Lab.
STUDY OF DYNAMICAL S-MATRIX EQUATIONS WITH REGGE BEHAVIOR
C. Edward Jones (Thesis) 31 Oct. 1963 100 p refs
(Contract W-7405-eng-48)
(UCRL-11125) OTS: $2.25

The modified N/D equations with Regge behavior, originally proposed by Chew, are studied. An exact version of the dynamical equation is formulated, and it is shown to be of a combined Wiener–Hopf–Fredholm type. The principle of Maximal Analyticity of the Second Degree is demonstrated as a tool for defining, unambiguously and free of arbitrary parameters, the dynamical equations and their solutions at low values of angular momentum. The so-called strip approximation to the equations, embodying a crossing symmetric Regge representation, is discussed, and the validity of the approximation scheme is verified. An investigation is made into the high-energy behavior of the Regge poles and residues that result as solutions to the dynamical equations in both the exact problem and in the strip approximation. Author

N64-15342 Joint Publications Research Service, Washington, D.C.
THE USE OF STATISTICAL METHODS IN STUDYING THE FINITE-DIFFERENCE STRUCTURE OF THE BALANCE EQUATION
M. I. Yudin and I. L. Vulis 18 Feb. 1964 10 p refs Transl. into ENGLISH of an article from Dokl. Akad. Nauk SSSR (Moscow), v. 153, no. 5, 1963 p 1067–1070
(JPRS-23267; OTS-64-21581) OTS: $0.50

Considered are the errors of the difference approximation of the balance equation:

$$l\nabla^2\psi + 2\left[\frac{\partial^2\psi}{\partial x^2}\frac{\partial^2\psi}{\partial y^2} - \left(\frac{\partial^2\psi}{\partial x\,\partial y}\right)^2\right] + \frac{\partial\psi}{\partial x}\frac{\partial l}{\partial x} + \frac{\partial\psi}{\partial y}\frac{\partial l}{\partial y} = \nabla^2\Phi.$$

Here l = the doubled vertical angular velocity component of the earth's rotation, ψ = the function of the current, Φ = the geopotential, x, y = the horizontal coordinates, and ∇^2 = the two-dimensional Laplace operator in the plane x, y. The equation is used extensively in the practice of making numerical weather forecasts and for calculating the wind field based on the field of the geopotential. In this connection, a transition from differential to difference operators is accomplished. Author

N64-15367 System Development Corp., Santa Monica, Calif.
FLIGHT SPECIFIC COMPUTER PROGRAM DESCRIPTION ALARM CLOCK (ALACK). MILESTONE II
D. J. Persico 28 Mar. 1963 22 p refs
(Contract AF 19(628)-1648)
(TM-(L)-742/006/00; AD-402209)

Program Alarm Clock (ALACK) computes the positions of a satellite at specified time increments after acquisition by any of the following stations—1 (COOK), 5 (HULA), and 6 (BOSS). Usage, restrictions, storage requirements, validation tests, and timing are discussed. C.L.W.

N64-15375 Emmanuel Coll., Boston, Mass. Research Language Center
THE THEORY OF PLANIGONS [TEORIYA PLANIGONOV]
B. N. Delaunay Bedford, Mass., AFCRL [1963] 42 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Mat. (Moscow), v. 23, 1959 p 365–386
(Contract AF 19(604)-8505)
(E-T-R-63-9; AD-429725)

E. S. Fedorov termed a polygon a planigon if its surfaces could be covered with polygons that are equal, or equal and symmetrical, to it, so that no two of them have common internal points. Thus, each of these polygons is surrounded to infinity by all the others. In this report, the subdivisions of a plane into fundamental regions for two-dimensional Fedorov groups are investigated. A complete new theory of general planigons and also of Dirichlet planigons of a Euclidean space is proposed, using one essentially proper topological lemma of Shubnikov and Laves. All possible contiguity symbols are determined that set those motions, by means of which a given fundamental region passes over into regions contiguous to it. A new purely topological conclusion for two-dimensional Fedorov groups was obtained, i.e., the problem of subdivisions is combinatorial in a topological sense. I.v.L.

N64-15393 Bettis Atomic Power Lab., Pittsburgh, Pa.
EQUATIONS AND PROGRAMS FOR SOLUTIONS OF THE NEUTRON GROUP DIFFUSION EQUATIONS BY SYNTHESIS APPROXIMATIONS
S. Kaplan, O. J. Marlowe, and W. R. Cadwell Dec. 1963 72 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-TM-377) OTS: $1.75

This report presents a method for constructing approximate solutions to the three-dimensional-group diffusion equations using only one- and two-dimensional programs. The computer programs that have been developed to carry out this construction are described, and instructions given for their use. Author

N64-15419 Joint Publications Research Service, Washington, D.C.
SOME THEOREMS OF THE THEORY OF ψ-STABILITY IN COOPERATIVE GAMES
O. N. Bondareva 25 Feb. 1964 7 p refs Transl. into ENGLISH of an article from Dokl. Akad. Nauk SSSR (Moscow), v. 153, no. 1, 1963 p 61–63
(JPRS-23376; OTS-64-21639) OTS: $0.50

Some theorems are given, along with their corollarys and proofs, that relate to the theory of stability in cooperative games. P.V.E.

N64-15422 Mathematics, Inc., Princeton, N.J.
APPLICATIONS OF STATISTICAL METHODOLOGY TO ARMS CONTROL AND DISARMAMENT, SECTIONS I AND II Final Report
F. J. Anscombe, Morton D. Davis, Harold W. Kuhn, Michael Maschler, H. D. Mills et al Jun. 1963 181 p refs
(Contract ACDA/ST-3)

This report contains the following papers: (1) "Some Principles of Sampling"; (2) "The Application of the Principles of Auditing and Sampling to Disarmament Inspection"; (3) "Inspection Against Clandestine Rearmament"; and (4) "Inspection against Clandestine Rearmament: Approximate Solutions and Analysis." I.v.L.

N64-15480 Massachusetts Inst. of Tech., Cambridge
STUDIES IN OPTIMUM FILTERING OF SINGLE AND MULTIPLE STOCHASTIC PROCESSES Scientific Report No. 7
S. M. Simpson, E. A. Robinson, R. A. Wiggins, and C. I. Wunsch 30 Jun. 1963 142 p refs
(Contract AF 19(604)-7378; ARPA Order 180-61, Amendment 2; Proj: Vela-Uniform)
(AFCRL-64-241; AD-428509)

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1. DISCRETE FILTERS FOR DIGITAL DATA E. A. Robinson p 8–63 refs (See N64-15481 07-20)

2. NORMAL EQUATION FORMS IN OPTIMUM FILTERING PROBLEMS R. A. Wiggins p 64–79 (See N64-15482 07-20)

3. RECURSIVE SCHEMES FOR NORMAL EQUATIONS OF TOEPLITZ FORM R. A. Wiggins, E. A. Robinson, and S. M. Simpson, Jr. p 80–99 (See N64-15483 07-20)

4. THE WIENER-MASANI TECHNIQUE OF MULTIPLE SPECTRAL FACTORIZATION C. I. Wunsch p 100–140 refs (See N64-15484 07-20)

N64-15481 Massachusetts Inst. of Tech., Cambridge

DISCRETE FILTERS FOR DIGITAL DATA

Enders A. Robinson *In its* Studies in Optimum Filtering of Single and Multiple Stochastic Processes 30 Jun. 1963 p 8–63 refs (See N64-15480 07-20)

The following topics are discussed: (1) matched filters, (2) modified matched filters, (3) modified matched filters for a multiparameter model, (4) elimination of the trend components, (5) time-invariant filters, (6) time-invariant filters in the noiseless case, (7) spike filters, (8) time-varying filters, (9) detection filters, (10) computational aids, and (11) squared-magnitude devices. R.T.K.

N64-15482 Massachusetts Inst. of Tech., Cambridge

NORMAL EQUATION FORMS IN OPTIMUM FILTERING PROBLEMS

Ralph A. Wiggins *In its* Studies in Optimum Filtering of Single and Multiple Stochastic Processes 30 Jun. 1963 p 65–79 (See N64-15480 07-20)

The normal equations for single process, and multiinput and multidimensional processes in optimum filtering problems are developed. R.T.K.

N64-15483 Massachusetts Inst. of Tech., Cambridge

RECURSIVE SCHEMES FOR NORMAL EQUATIONS OF TOEPLITZ FORM

Ralph A. Wiggins, Enders A. Robinson, and Stephen M. Simpson, Jr. *In its* Studies in Optimum Filtering of Single and Multiple Stochastic Processes 30 Jun. 1963 p 80–99 (See N64-15480 07-20)

The solution of the least-square optimum filtering problem involves solving a set of simultaneous equations. In general, there is one equation for each coefficient in the filter. The time and space requirements of a standard simultaneous equation computer routine for such filters is prohibitive for almost all nontrivial problems. Several more efficient schemes for arriving at the desired filter are outlined in this report. The following types of equations are discussed: (1) single processes—the Levinson–recursion to larger operators; (2) multi-input processes—recursion to larger operators and recursion to move output origin; and (3) multi-dimensional processes—recursion to larger operators. R.T.K.

N64-15484 Massachusetts Inst. of Tech., Cambridge

THE WIENER-MASANI TECHNIQUE OF MULTIPLE SPECTRAL FACTORIZATION

Carl I. Wunsch *In its* Studies in Optimum Filtering of Single and Multiple Stochastic Processes 30 Jun. 1963 p 100–140 refs (See N64-15480 07-20)

The prediction problem for single stationary time series is reviewed, and the least square and Kolmogoroff solutions are given. Extension is then made to the multiple case, the least squares equations are set up, and the Wiener–Masani factorization is described. Heuristic use is made of the Hilbert space property of the time series. A digital computer program for performing the Wiener–Masani factorization is discussed. Author

N64-15522 ARO, Inc., Arnold Air Force Station, Tenn.

ANALOGUE SIMULATION OF THE DYNAMIC EQUATIONS OF ATMOSPHERIC BALLISTIC RE-ENTRY

Paul M. Beckham and Henry F. Tisdale Arnold Eng. Develop. Center, Jan. 1964 62 p refs

(Contract AF 40(600)-1000)

(AEDC-TDR-63-257; AD-428568)

With the advent of improved and highly accurate analog computing equipment, it was felt that the equations of reentry, previously solved almost exclusively by digital computing equipment, could easily be adapted to the analog computer. This report describes the procedures followed to make the dynamic equations of ballistic reentry compatible to analog simulation techniques. Considering four sets of initial conditions, the equations is solved on an EAI PACE 231R Analog Computer and an IBM 7074 Digital Computer, and the results compared. Author

N64-15526 General Dynamics Corp., San Diego, Calif.

GGC-II. A PROGRAM FOR USING THE GAM-II AND GATHER-II SPECTRUM CODES IN PREPARING MULTIGROUP CROSS-SECTION INPUT ON PUNCHED CARDS FOR THE GAZE, GAZED, DSN, GAPLSN, 2DXY, TDC, GAMBLE, FEVER, AND GAD CODES

C. V. Smith and H. A. Vieweg 17 Dec. 1962 35 p refs

(GA-4436)

The GGC-II program, programed for use on an IBM-7090 computer with a 32K memory, is written for the most part in the FORTRAN-II language, with some use of FAP machine language where it is deemed expedient. The program operates under the standard 32K FORTRAN Monitor System. Complete use of all features of the GGC-II program in a single run without operator intervention requires eleven tape units on two data channels, not including the system monitor (and system library tape, if separate). The program is divided into three main sections, each of which may be run independently of the others, or the three sections may be used in any combination. The three sections are the GAM-II, or fast spectrum, Section; the GATHER-II, or thermal spectrum, Section; and the Combine-and-Punch Section. R.L.K.

N64-15529* Technical Products Co., Los Angeles, Calif.

ANALYTICAL STUDY OF VIBRATION DATA REDUCTION METHODS

Julius S. Bendat, Loren D. Enochson, and Allan G. Piersol Sep. 1963 327 p refs

(NASA Contract NAS8-5093)

(NASA CR-55576) OTS: $19.75 ph, $10.01 mf

This report discusses analog and digital data reduction methods for the analytical study of vibration data. Emphasis is placed on basic characteristics of vibration data to be analyzed. General techniques are developed appropriate to both periodic data and random data. Practical considerations are included for such matters as analog instrumentation parameters and digital sample sizes which limit accuracy of desired measurements. Material on the interpretation and evaluation of data is illustrated with numerous engineering examples to make the results as meaningful as possible. Author

N64-15542* Alabama U. Research Inst., Huntsville
GREEN'S FUNCTIONS FOR THE PARALLEL-WALL WAVEGUIDE
F. J. Tischer Jan. 1964 11 p refs
(NASA Grant NsG 381)
(NASA CR-55653; UARI-RR-13) OTS: $1.60 ph, $0.80 mf

A method is presented for the determination of the two-dimensional Green's functions for the scalar wave equation for a region between two parallel lines. These functions are useful for the consideration of electromagnetic parallel-wall waveguides. The approach is based on using electromagnetic boundary conditions. Author

N64-15543* Minneapolis-Honeywell Regulator Co., Minn.
ROCKET BOOSTER CONTROL, SECTION 6. TIME-OPTIMAL BOUNDED PHASE COORDINATE CONTROL OF LINEAR RECURRENCE SYSTEMS
E. B. Lee 26 Dec. 1963 12 p refs
(NASA Contract NASw-563)
(NASA CR-55430; MH MPG 1541-TR 6) OTS: $1.60 ph, $0.80 mf

The time optimal control problem with bounded phase coordinates is considered for systems modeled by linear recurrence equations. It is shown that linear inequality constraints of the phase coordinates can be transformed into similar linear inequality constraints on the control variables. Methods for finding the so-constrained minimum are discussed. A convergent computational scheme is presented, which, unfortunately, involves a large amount of equipment for implementation. It does not seem practical to solve this problem on line using present computer technology. Author

N64-15544* Minneapolis-Honeywell Regulator Co., Minn.
ROCKET BOOSTER CONTROL, SECTION 11. A NOTE ON SYSTEM TRUNCATION
E. R. Rang 19 Nov. 1963 19 p refs
(NASA Contract NASw-563)
(NASA CR-55567; MH MPG 1541-TR 11) OTS: $1.60 ph, $0.80 mf

The problem of control design of high-order systems based on the characteristics of the lower-order essential elements of the system is considered by an approximation of the asymptotic type, sometimes called singular perturbation. A preliminary general development is given, and detailed calculations for a simple problem are written out. These results indicate that the technique leads to the same design found by previous investigators, and the only advantage appears to be an estimate of errors. Author

N64-15545* Minneapolis-Honeywell Regulator Co., Minn.
ROCKET BOOSTER CONTROL, SECTION 16. AN ALTERNATE DERIVATION AND INTERPRETATION OF THE DRIFT-MINIMUM PRINCIPLE
C. A. Harvey 22 Nov. 1963 16 p refs
(NASA Contract NASw-563)
(NASA CR-55344; MH MPG-1541-TR 15) OTS: $1.60 ph, $0.80 mf

The design of a control system for a plant with disturbance inputs is considered. The motion of the plant is assumed to be described by n linear, first-order, constant-coefficient differential equations forced with a scalar control variable and a scalar disturbance. A linear, fixed-gain controller is assumed. In some cases, it is possible to choose the gains in such a manner that a certain type of invariance to disturbances is obtained for the resulting controlled system. Conditions for obtaining such invariance are derived using the concept of complete controllability. The drift-minimum condition is obtained as a specific example. Author

N64-15548* Illinois U., Urbana
THE RESTRICTED PROBLEM OF THREE BODIES Technical Report No. 1,
James H. Bartlett 15 Dec. 1963 61 p refs Submitted for Publication
(NASA Grant NsG-280-63)
(NASA CR-55539) OTS: $6.60ph, $2.03 mf

Discussion is restricted to the case of equal finite masses. Curves and tables are presented that show how most of the main classes of Strömgren develop continuously. Equations of motion, periodic solutions, and the locations of periodic solutions are given. R.T.K.

N64-15587 Avco-Everett Research Lab., Everett, Mass.
NONLINEAR REGRESSION ANALYSIS
Melvin F. Shakun (Rutgers U.) Oct. 1963 15 p refs
(Contract AF 04(694)-33; Contract DA-19-020-AMC-0210)
(BSD-TDR-63-239; AMP-130; AD-429310)

Aspects of nonlinear regression analysis are discussed, and solution techniques by iteration are demonstrated via an illustrative example. Analytical and computational details, as well as numerical results, are given. Author

N64-15615 European Organization for Nuclear Research, Geneva (Switzerland) Data Handling Div.
PROGRAMMING FOR HPD AND OTHER FLYING SPOT DEVICES
J. M. Howie, S. J. Mc Carroll, B. W. Powell, and A. Wilson, eds. 21 Oct. 1963 301 p refs Proc. of a meeting held at the Coll. de France, Paris, 21–23 Aug. 1963 Meeting organized in conjunction with the Lab. de Phys. Nucl. and Coll. de France, Paris
(CERN-63-34)

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23. PIP: A PHOTO-INTERPRETIVE PROGRAM FOR THE ANALYSIS OF SPARK CHAMBER DATA (ABSTRACT) H. Rudloe, T. Marill (Bolt, Beranek and Newman, Inc.) and M. Deutsch (MIT) p 231–235

24. CURRENT STATUS OF THE DIGITAL PATTERN RECOGNITION PROGRAM AT BNL G. Rabinowitz (Brookhaven Natl. Lab.) 22 p

25. A PROGRAMMING SYSTEM FOR SCANNING DIGITIZED BUBBLE CHAMBER NEGATIVES (ABSTRACT) R. Narasimhan (Ill. U.) p 255–257 refs

26. LUCIOLE H. Anders, T. Lingjaerde, J. A. Wilson, and D. Wiskott 8 p refs

N64-15649* Wisconsin U., Madison Theoretical Chemistry Inst.

ON THE INVERSION OF EIGENVALUE PROBLEMS

Egil A. Hylleraas Repr. from Phys. Math. (Blindern), Inst. Rept. 20 [1963] 20 p refs

(NASA Grant NsG-275-62)

(WIS-TCI-15)

Generalizations and explanations concerning the inverse scattering problem in quantum mechanics are presented. In addition, several inconveniences and some weak points of current theories are pointed out. I.v.L.

N64-15704 Naval Postgraduate School, Monterey, Calif.

FEEDBACK CONTROL SYSTEMS: DESIGN WITH REGARD TO SENSITIVITY

Bui Tien Rung (Viet Nam Navy) and George J. Thaler Jan. 1964 66 p refs

(Res. Rept. 41; AD-429388)

This paper starts with a definition of "root sensitivity," relating changes in the plant's parameters to corresponding changes in the system's roots. Interesting properties of root sensitivity are shown and then applied to the derivation of a laborless graphical method for obtaining the sensitivity of a given root. Finally a compensation design method is proposed, which not only secures a desired location for the system's dominant roots on the s-plane, but also simultaneously satisfied conditions concerning the sensitivity of these dominant roots to the varying plant parameter. Examples are solved using the proposed method, and the results verified with the analog computer. Author

N64-15717 European Atomic Energy Community, Brussels (Belgium)

PATTERN DISPLAY CONSIDERATIONS FOR A PROGRAMMING AID MACHINE LINKING A DIGITAL AND AN ANALOGUE COMPUTER

W. Becker and I. De Lotto Joint Nuclear Res. Center, Ispra Establishment (Italy), 1963 26 p refs

(EUR-410.e) Available from Belgian American Bank and Trust Co., N.Y., account No. 121.86: 40 BF

A short introduction to the question of auxiliary means linking the output of a digital computer to the patch panel of an analog computer, in order to assist in setting up the connections on the patch panel, is given. These connections, which are a transformation of a set of addresses delivered by the digital computer, represent the program for the analog computer. A general survey of existing or proposed solutions for the problem of panel display is presented concerning evacuated arrangements, solid-state, gaseous, and liquid display types, mechanical and optical systems, and neon- and tungsten-bulb matrices. A method for the calculation of crosstalk in a tungsten-bulb matrix is shown, and the summing up of reverse currents in the matrix is considered. The problem of using a minimum number of components in a decoder is discussed, as well as the question of eventual overloading of some driving transistors for the decoder, caused by an unsuitable distribution of component tolerances. Finally, a short explanation of the instrument block-diagram is given. Author

N64-15736 Parke Mathematical Labs., Inc., Carlisle, Mass.

ON ERROR-CORRECTING, VARIABLE-LENGTH CODES Scientific Report No. 9

L. Calabi Dec. 1963 56 p refs

(Contract AF 19(604)-7493)

(Rept. 7493-SR-9; AFCRL-64-9; AD-430198)

Binary, variable lenght codes are introduced that are capable of detecting and correcting transmission errors. The study of prefix codes, and of block codes with distance d, are considered special cases of the theory developed in this report. Author

N64-15750 California U., Los Angeles

MULTIPLIERS OF p-INTEGRABLE FUNCTIONS

Alessandro Figá-Talamanca (Ph. D. Thesis) Jan. 1964 46 p refs

(Sponsored by Navy Dept.)

(AD-429515) OTS: $4.60

Let G be a locally compact Abelian group. Let $L^p(G)$ $(1 < p < \infty)$ be the space p-integrable functions on G(with respect to the Haar measure). The space M_p of multipliers on $L^p(G)$ is defined as the space of bounded operators on $L^p(G)$ that commute with translations by elements of G(that is, $Tr_y = r_y T$ for every $T \in M_p$ and $y \in G$, where $(r_y f)(x) = f(x+y)$). It is proved that M_p is the conjugate space of a Banach space A_p of continuous functions on G. A_p can be identified with a quotient space of the (completed) Kronecker product $L^p(G) \otimes L^q(G)$ $(1/p + 1/q = 1)$. As a direct consequence, one obtains that M_p is the closure in the weak (strong) operator topology of the span of the translation operators. These results are

applied to the study of "translates" of multipliers and to the relations between multipliers and lacunary sets of the character group Γ of G (for the case of a compact group G).

Author

N64-15763 Naval Ordnance Lab., White Oak, Md.
REMARKS ON A MIXED BOUNDARY VALUE PROBLEM FOR LINEAR HYPERBOLIC PARTIAL DIFFERENTIAL EQUATIONS IN TWO INDEPENDENT VARIABLES
Sherwood C. Chu and J. B. Diaz Mar. 1964 21 p refs
(NOLTR-63-278; AD-430253)

An existence and uniqueness theorem is given for the boundary value problem: $L(u) = u_{xy} + au_x + bu_y + cu = d$ in R; $\alpha_0(x)u + \alpha_1(x)u_x = \sigma(x)$, on $y = f_1(x)$; $\beta_0(y)u + \beta_2(y)u_y = \tau(y)$, on $x = f_2(y)$; $u(x^*,y^*) = \gamma$, where R is the closed rectangle with sides parallel to the coordinate axes, and opposite vertices (0,0) and (x_o,y_o), where $x_o,y_o > 0$. Author

N64-15798 Martin Co., Baltimore, Md. RIAS
ASYMPTOTIC FIXED POINT THEOREMS AND PERIODIC SYSTEMS OF FUNCTIONAL-DIFFERENTIAL EQUATIONS
G. Stephen Jones Repr. from Contrib. to Differential Equations, 1963 p 385–405 refs (Previously published as TR-63-12; see N63-19029 18-20)
(NASA Contract NASr-103; Contract AF 49(638)-382; Contract Nonr-3693(00))

A theorem, asserting the existence of a fixed point under a mapping f by utilizing information known about the nth power composite mapping f^n for n sufficiently large, is described as an asymptotic fixed-point theorem. R.T.K.

N64-15814 Syracuse U. Research Inst., N.Y.
THEORY OF ADAPTIVE MECHANISMS Final Report
M. K. Hu, E. Kletsky, S. Goldman, E. Stabler, and M. Krieger Griffiss AFB, N.Y., RADC, Dec. 1963 110 p refs
(Contract AF 30(602)-2543)
(EE894-6307F; RADC-TDR-63-334; AD-429935)

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PART III. EXPERIMENTAL STUDIES OF PATTERN RECOGNITION USING MOMENT INVARIANTS E. Kletsky p 66–86 refs (See N64-15816 07-20)

PART IV. THRESHOLD LOGIC, APPENDIX A p 87–97 (See N64-15817 07-20)

N64-15815 Syracuse U. Research Inst., N.Y.
THEORY OF MOMENT INVARIANTS AND ITS APPLICATIONS TO ADAPTIVE PATTERN RECOGNITION
M. K. Hu *In its* Theory of Adaptive Mech. Dec. 1963 p 16–65 refs (See N64-15814 07-20)

Generalizations concerning machines with automatic visual pattern or character recognition are presented. The mathematical background that is used in developing the theory of moment invariants is described. A fundamental theorem on moment invariants is given as follows: If the algebraic form of order p has an algebraic invariant, $I(a'_0,\ldots, a'_p) = \Delta^i I(a_0,\ldots, a_p)$ then the moments of order p have the same invariant except the additional factor $|J|$. $I(\mu'_{p0},\ldots, \mu'_{0p}) = |J| \Delta^i I(\mu_{p0},\ldots, \mu_{0p})$; this theorem holds also between algebraic invariants containing coefficients from two or more forms of different orders and moment invariants containing moments of the corresponding orders. A number of complete systems of moment invariant under various elementary transformations are derived. The method of decomposition is introduced to form complete systems of moment invariants under general transformations. Some pattern recognition models are discussed. P.V.E.

N64-15816 Syracuse U. Research Inst., N.Y.
EXPERIMENTAL STUDIES OF PATTERN RECOGNITION USING MOMENT INVARIANTS
E. Kletsky *In its* Theory of Adaptive Mech. Dec. 1963 p 66–86 refs (See N64-15814 07-20)

Experimental studies, based on a program incorporating second-order moments and displaying both recognition and simple learning, are described. The main area of discussion is concerned with receptor simulation. A program that incorporates third-order moments, making it possible to simulate a receptor providing six-moment invariants, is described. Experiments involving the latter program are also described. P.V.E.

N64-15817 Syracuse U. Research Inst., N.Y.
THRESHOLD LOGIC, APPENDIX A
M. Krieger *In its* Theory of Adaptive Mech. Dec. 1963 p 87–97 (See N64-15814 07-20)

A discussion is presented of threshold logic and includes the following: (1) the transition between majority and threshold gates, (2) Boolean functions realizable by one threshold element, and (3) basic properties of linearly separable functions. P.V.E.

N64-15823 Naval Postgraduate School, Monterey, Calif.
THE SYNTHESIS OF OPTIMUM AND QUASI-OPTIMUM MINIMUM TIME CONTROLS FOR SECOND ORDER SYSTEMS
Harold Titus and James Demetry Sep. 1963 28 p refs
(Supported in part by ONR)
(Research Paper 38; AD-429415)

This paper discusses briefly the digital and analog synthesis of several optimum and quasi-optimum minimum-time controls for systems with real, null, and complex eigenvalues. Controls are designed using nonlinear feedback. An example of the control of a nonlinear system is given using a technique that is effectively a linearization of the system about each state point on a trajectory. A quasi-optimum minimum-time control is generated by substituting the nonlinear functions of the states for their respective linearized characteristics. Author

N64-15827 California U., Livermore. Lawrence Radiation Lab.
YOGI-N: A NEUTRON MONTE CARLO PROGRAM
Simon Kellman and Joseph Pettibone 16 Dec. 1963 104 p refs
(Contract W-7405-eng-48)
(UCRL-7630)

YOGI-N is a neutron Monte Carlo program written in FORTRAN II language for the IBM 7090/7094 computer with LRL monitor control. The code computes neutron absorption in selected rectangular and cylindrical systems. In relatively simple geometries, the program processes more than 5,000 collisions per minute. In order to keep the code simple, the

only collision processes considered are elastic scattering, isotropic in the center-of-mass system, and capture. The number of captures per zone and the corresponding variances are computed. In addition to the straight tally, two expected-value calculations of neutron absorption in each zone and in each energy sector of every material region are available in order to improve statistical accuracy. Author

N64-15839 Nuklearni Institut Josef Stefan, Ljubljana (Yugoslavia)
SOME ALGORITHM THEORY AND ITS APPLICABILITY
Anton P. Zeleznikar Oct. 1963 18 p refs Submitted for Publication
(NIJS-R-418)

An exact definition of the general notion of an algorithm was first introduced by A. A. Markov. The new idea of an algorithm described in this article has many concepts in common with normal algorithms. The newly defined algorithm and the theory related to it were developed as a starting point by the examination of constructive processes and digital automata synthesis. In the proposed definition, the action of the algorithm is in principle an integral one. Some arithmetic algorithms are described, and examples are given. E.W.

N64-15840* Michigan U., Ann Arbor
ON STATIONARITY CONDITIONS FOR A CERTAIN PERIODIC RANDOM PROCESS
Frederick J. Beutler Repr. from J. Math. Anal. Appl., v. 3, no. 1, Aug. 1961 p 25–36 refs
(NASA Grant NsG-2-59)

A study was made of the statistical analysis of a periodic signal x(t) accompanied by additive noise (t) (assumed stationary and independent of x(t)). R.T.K.

N64-15844* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
FORTRAN PROGRAM FOR COMPUTING THE PRINCIPAL MOMENTS OF INERTIA OF A RIGID MOLECULE
Janet G. Ehlers and Glenn R. Cowgill Washington, NASA, Feb. 1964 45 p refs
(NASA TN D-2085) OTS: $1.25

This program eliminates considerations of symmetry and avoids hand calculations by reducing the input to structural parameters, that is, bond lengths and angles. The assignment of the structural parameters follows geometric models. In its present form, the program is written for molecules with not more than 24 atoms. Author

N64-15919 Hungarian Academy of Sciences, Budapest Central Research Inst. for Physics
ON RESONANCES IN THE FORMAL THEORY OF SCATTERING
T. Dolinszky 1963 24 p refs
(KFKI-1467; KFKI-20/1963)

Using the formalism of Schwinger and Lippmann for scattering, an attempt is made to determine the poles of the scattering matrix in the case of a central one-body potential going to infinity. To this end the operand in the scattered wave is developed into the discrete Weyl series of the appropriate Coulomb eigenfunctions. The matrix element is obtained in a dispersion structure. The resonance equations determining the poles contain, as compared to the Humblet–Rosenfeld theory, an additional term representing the asymptotical behavior of the potential. It is shown that the class of the "physical solutions" of the Schroedinger equation coincides with that of the resonance states. A decomposition of the stationary wave function into a compound and a direct contribution is proposed. The integral equation with built-in-boundary conditions of the resonance states is given. Author

N64-15920 Laboratoire de Physique Théorique et des Hautes Energies, Orsay (France)
A NEARBY SINGULARITY PREDICTION OF A RESONANCE
B. Diu and H. R. Rubinstein Jan. 1964 6 p refs

Evidence is presented for the existence of a resonance with quantum numbers $B = 0$, $S = 0$, $I^G = 1^-$, $J^P = 0^+$. The rule can be stated as follows: given a two-body amplitude, such that elastic unitarity holds at least in a region of the right-hand cut, then the sign of the effective potential is given by the one-particle exchange graphs of the corresponding crossed channels. R.T.K.

N64-15928 Du Pont De Nemours (E. I.) and Co., Aiken, S.C. Savannah River Lab.
AN ANALOG COMPUTER FOR THE SOLUTION OF LINEAR SIMULTANEOUS EQUATIONS
Robert C. Propst and Robert F. Overman Dec. 1963 22 p refs
(Contract AT(07-2)-1)
(DP-846) OTS: $0.50

A desk-top computer was designed to solve up to nine simultaneous linear equations rapidly by means of an iterative technique and an oscilloscopic display system. The instrument contains a precision potentiometer, precision resistors, operational amplifiers, and a Zener regulated voltage supply in a d.c. circuit. An accuracy of 0.2% can be obtained for the solution of the major variable. Author

N64-15943 Brown U., Providence, R. I. Div. of Applied Mathematics
UNIQUENESS THEOREMS IN THE LINEAR THEORY OF ANISOTROPIC VISCOELASTIC SOLIDS Technical Report No. 24
W. S. Edelstein and M. E. Gurtin Feb. 1964 27 p refs
(Contract Nonr-562(25))
(AD-429806)

Some uniqueness theorems appropriate to dynamic linear viscoelasticity theory (small deformations) are proved. In order to facilitate the statement of these theorems, three possible conditions on the tensor $\underline{G}(\underline{x},t)$ of relaxation moduli are defined. R.T.K.

N64-15946 Carnegie Inst. of Tech., Pittsburgh, Pa.
LINEAR FUNCTIONALS ON ORLICZ SPACES Technical Report No. 11
M. M. Rao Jan. 1964 37 p refs
(Contract DA-36-061-ORD-447; NSF Grant GP-1349)
(CIT-ORD-16-TR-11; AROD-128012; AD-429861)

A global representation theorem for bounded linear functionals on Orlicz spaces is presented, without any restrictions on the complementary Young's functions or the underlying measure space. Then with certain growth conditions on the Young's functions or assuming the measure space to be localizable (or sigma-finite), the general result is specialized to obtain particular cases. These are compared with the known results. As an application of this work, a result in statistical theory on the existence of "optimal" estimators, relative to general convex loss functions, is extended. Author

N64-15951 Polytechnic Inst. of Brooklyn, N.Y. Microwave Research Inst.

OPTIMAL CONTROL OF LINEAR PLANTS WITH RANDOM PARAMETERS

R. F. Drenick and L. Shaw 15 Nov. 1963 27 p refs
(Contract DA-ARO(D)-31-124-G144)
(PIBMRI-1200-63; AROD-153827; AD-429847)

The optimal control of linear plants whose coefficients and whose reference signals are random processes are studied. Discrete-time and continuous-time problems are treated, and some fairly deep-seated distinctions between the two are pointed out. Special emphasis is placed on control over long periods of time. A set of assumptions is laid down under which the transition to infinitely long periods of operation is tractable. It is shown that a discrete-time plant is controllable, in the sense that the rate of the mean-squared error remains finite, only when certain necessary and sufficient conditions are fulfilled by the statistics of the plant parameters. There is no similar constraint for controllability of analogous continuous time plants. Author

N64-15953 Columbia U., New York, N.Y. Electronics Research Labs.

SEQUENTIAL DESIGN OF EXPERIMENTS WITH TWO RANDOM VARIABLES

L. R. Abramson 20 Sep. 1962 113 p refs
(Contract AF 49(638)-1113; ARPA Order 279-62)
(CU-7-62-AF-1113-ERL; Tech. Rept. T-2/180; AD-295617)

Given two independent random variables with densities f_1 and f_2, H_1: $f_1 = f_{11}$, $f_2 = F_{12}$ versus H_2 : $f_1 = f_{21}$, $f_2 = f_{22}$ is tested, where the f_{ij} (i,j = 1,2) are known densities. Bayes sequential procedures are studied, and it is proved that a Bayes decision rule always exists. However, since the approach gives very little specific information about the Bayes sampling rule, the asymptotic case is considered where the cost of each observation approaches zero. An asymptotic expression for the Bayes risk is found, and necessary and sufficient conditions for a decision rule to be asymptotically Bayes are derived. The properties of a class of tests, called tandem tests, are studied, and necessary and sufficient conditions for a tandem test to be asymptotically Bayes are found. Author

N64-16046 RAND Corp., Santa Monica, Calif.

SOVIET CYBERNETICS TECHNOLOGY, III: PROGRAMMING ELEMENTS OF THE BESM, STRELA, URAL, M-3, AND KIEV COMPUTERS

Willis H. Ware and Wade B. Holland, ed. Sep. 1963 87 p refs
Transl. into ENGLISH of an appendix from the book "Elementy Programmirovaniya"
(Contract AF 49(638)-700; Proj. RAND)
(RM-3804-PR; AD-419487)

This memorandum is a translation of the appendix of the book Elements of Programming. It details the command structures and systems of notation for the five Soviet computers: BESM, Strela, Ural, M-3, and Kiev. Some specifications for each of the computers are included, as are summaries of the operations codes for the five machines in chart form. Author

N64-16056 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

THE STUDY OF CORRELATED RANDOM VALUES

G. A. Stepan'yants 13 Nov. 1962 8 p refs Transl. into ENGLISH from Vopr. Avtomat. Regulir. Dvizhushchikhsya Ob'yektov (Moscow), Issue 139, 1961 p 129–133
(FTD-TT-62-1191/1+2+4; AD-292609)

This study was designed to determine characteristics other than the coefficient of correlation, that can determine the relationship between random values. It was concluded that the parity coefficient and the parity function can be used to describe the relationship between two random values, and also to study the nature of a random process. R.T.K.

N64-16082 RAND Corp., Santa Monica, Calif.

A NOTE ON DIFFERENTIAL APPROXIMATION AND ORTHOGONAL POLYNOMIALS

Richard Bellman Mar. 1963 10 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-3482-PR; AD-299487)

A simple analytic technique is considered for finding linear differential equations that are approximately satisfied by a given function, and thus obtain approximations to a given function by a sum of exponentials. Author

N64-16090 Wisconsin U., Madison Mathematics Research Center

ON MEROMORPHIC TYPICALLY-REAL FUNCTIONS

E. P. Merkes Oct. 1963 16 p refs
(Contract DA-11-022-ORD-2059)
(MRC-425; AD-430768)

Let TM_1 denote the class of functions f(z) that are typically real and meromorphic in the complex plane with slits on the real axis, analytic at z = 0, and normalized by f(0) = 0, f'(0) = 1. Characterizations of this class and a related class of functions are obtained as Stieltjes transforms and as bounded real J-fractions. From these representations, the exact regions of variability of functions in TM_1 and of their first derivatives are derived. Finally, sharp regions of univalence of certain subclasses of TM_1 are given. Author

N64-16092 State U. of New York, Stony Brook

A TIME DOMAIN CHARACTERIZATION OF RATIONAL POSITIVE-REAL MATRICES First Scientific Report

A. H. Zemanian 5 Aug. 1963 32 p refs
Contract AF 19(628)-2981)
(AFCRL-63-390; AD-430564)

The following time-domain characterization of any rational positive-real matrix is established: Let $\mathbf{w}(t)$ be an n × n matrix distribution having its support bounded on the left, and let $\mathbf{W}(s)$ be its Laplace transform. The necessary and sufficient conditions for $\mathbf{W}(s)$ to be a rational positive-real matrix are the following: (1) $\mathbf{w}(t) = \mathbf{k}_1\delta^{(1)}(t) + \mathbf{k}_0\delta(t) + \mathbf{w}_1(t)$. Here, $\mathbf{k}_1$ is a real symmetric nonnegative-definite constant matrix, $\mathbf{k}_0$ is a real constant matrix, and $\mathbf{w}_1(t)$ is a real matrix distribution whose elements consist of finite linear combinations of terms of the form $u(t)\, t^{\nu}\, e^{-\gamma t}$, where ν is a nonnegative integer and γ is a complex constant. (2) Let $\mathbf{w}_h(t) = 1/2\ [\mathbf{w}(t) + \mathbf{w}^T(-t)]$. For every n × 1 constant vector $\mathbf{y}$ the quantity $\mathbf{y}^x\mathbf{w}_h(t)\mathbf{y}$ is a nonnegative-definite distribution. Author

N64-16093 State U. of New York, Stony Brook

A TIME DOMAIN CHARACTERIZATION OF POSITIVE-REAL MATRICES Second Scientific Report

A. H. Zemanian 16 Aug. 1963 12 p refs
(Contract AF 19(628)-2981)
(AFCRL-63-391; AD-430565)

The following time-domain characterization of any positive-real matrix is established: Let $\mathbf{w}(t)$ be n × n matrix distribution and let $\mathbf{W}(s)$ be its Laplace transform. Necessary and sufficient

conditions for W(s) to be a positive-real matrix are the following: (1) $w(t) = A\,\sigma^{(1)}(t) + w_0(t)$. Here, A is a real symmetric nonnegative-definite constant matrix, and $w_0(t)$ is a real matrix distribution of zero order, whose support is contained in $0 \leq t < \infty$. (2) Let $w_h(t) = 1/2[w(t) + w^T(-t)]$. For every $n \times 1$ constant vector y the quantity $y^* w_h(t)\, y$ is a nonnegative-definite distribution. Author

N64-16108* Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
A METHOD FOR THE NUMERICAL INTEGRATION OF OUPLED FIRST ORDER DIFFERENTIAL EQUATIONS WITH GREATLY DIFFERENT TIME CONSTANTS
Charles E. Treanor Jan. 1964 16 p refs
(NASA Contract NASr-119)
(NASA CR-55550; CAL-AG-1729-A-4) OTS: $1.60 ph, $0.80 mf

Coupled differential equations that describe the simultaneous reladation of different components at greatly different rates present a difficulty in numerical integration, since the integration interval is determined by the fastest rate, and the region of integration is determine d by the slowest rate. An integration formula is derived from the approximation that within an interval the first derivative can be edpressed as dy/dd = −Py + Q(d). The method is edact if the differential equation is of the form shown, where P is constant and Q(d) is a quadratic in d. The algorithm utilizes only the first derivative, and thus has a parallel to the Runge–Kutta method. For Ph small (where h is the integration interval) the method is identical to fourth-order Runge–Kutta and thus is correct to order h^4. Results for the coupled chemistry of high-temperature air are compared with results obtained from the usual Runge–Kutta procedure. Author

N64-16112* Maryland U., College Park
THE USE OF DIGITAL COMPUTERS TO DETERMINE DEFINITIONS FOR ABSTRACT GROUPS
James W. Snively, Jr. Nov. 1963 50 p refs
(NASA Grant NsG-398)
(NASA CR-55654; TR-63-4) OTS: $4.60 ph, $1.70 mf

This paper describes the work done on digital computer programs for automatic enumeration of cosets. It is followed by a brief description of some of the work done on the finite "Burnside" groups, especially by computer enumerations. A definition for the Burnside group $B_{3,4}$ of exponent 3 with 4 generators involving only 35 words is given. Author

21 METEOROLOGY

Includes climatology; weather forecasting; and lower atmosphere studies. *For related information see*: 05 Astronomy and Astrophysics; 12 Geophysics; and 29 Space Sciences.

N64-15064 Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
A STUDY OF THE DYNAMICS AND CLIMATOLOGY OF COLD OUTBREAKS IN THE FAR EAST
K. Suta 14 Jan. 1964 20 p refs Transl. into ENGLISH by JPRS from J. Meteorol. Res. (Tokyo), vl. 10, 1958 p 1053–1060
(RSIC-120; AD-428516)

An analysis of weather maps covering large areas clarified (1) the pattern of currents accompanying a pressure system with a high in the west and a low in the east and (2) the mechanism of a cold wave. The results of the investigation are summarized as follows: (1) When there is a low temperature over the northern part of Japan, a high pressure system on the upper level appears over the Arctic Ocean—the polar low pressure on the upper level is isolated and migrates to the south over the northern part of Japan. (2) The cold waves in the Far East are likely to take place when the atomospheric circulating streams assume a pattern with three wavelengths accompanied by pressure ridges over the eastern Atlantic, western Siberia, and the eastern Pacific. (3) The pressure pattern of a high in the west and a low in the east can be uniquely interpreted as due to the large scale migration of a cold airmass that is pushed by the formation of polar high pressure and the subsequent southward deviation and intensification of the average jetstream. P.V.E.

N64-15125 Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
RELATION BETWEEN AIR TEMPERATURE AND WEATHER
Tatsuo Fujii 9 Jan. 1964 11 p Transl. into ENGLISH by JPRS from Kishocho Kenkyu Jiho (Tokyo), v. 10, 1958 p 353–357
(RSIC-118; AD-428321)

Five-day average surface-temperature variation curves were compared with sunlight rate curves in an effort to study the relation between the cold air over the China mainland and the weather over Japan. The results indicate that there are mainly low pressures at the upper latitudes (near the poles) during the winter high-temperature period, and the Pacific subtropical zone shows a positive drift. A ridge develops over the Taimyr Peninsula during the winter low temperature period. A very pronounced southern flow takes place to the west of Honshu and reaches as far south as below 60° N latitude. When this reaches 60° N latitude, and the ridge developing from the Alaska area gives rise to a high-pressure area over the Bering Sea, a period of continued bad weather results. R.T.K.

N64-15152 Joint Publications Research Service, Washington, D.C.
PROBLEMS OF LONG-RANGE WEATHER FORECASTING
14 Feb. 1964 28 p refs Transl. into ENGLISH of 2 articles from Tr. Tsentral. Inst. Prognoyov (Moscow), no. 24, 1963 p 3–13 and 28–32
(JPRS-23237; OTS-64-21565) OTS: $0.75

CONTENTS:

1. RESULTS OF THE OPERATIONAL INVESTIGATION OF VARIOUS METHODS FOR MONTHLY WEATHER FORECASTING Yu. B. Khrabrov and V. F. Kozel'tseva p 1–19 refs
2. INFLUENCE OF SOLAR ACTIVITY ON THE FORMATION OF SYNOPTIC PROCESSES L. G. Borisova and B. G. Khesina p 20–25 refs

N64-15264 Space Technology Labs., Inc., Redondo Beach, Calif. Physical Research Div.
RESONANT-SCATTER DETECTION OF MIDCOURSE VEHICLES: MINIMUM DETECTABLE NUMBERS OF RESONANT-SCATTERING PARTICLES
Leonard Glatt *In* AF Systems Command Trans. of the 8th Symp. on Ballistic Missile and Space Technol., Vol. 2 [1963] p 309–334 refs (See N64-15251 07-01)
(Contract AF 04(694)-1)

Consideration is given to the possibility of resonant-scatter detection of the rarefied clouds surrounding midcourse vehicles. Minimum detectable numbers of resonant species particles are determined for two detection configurations: (1) a satellite-based downward-looking detection system operating in the 3,000 to 2,000 A spectral domain; (2) an upward-looking detection system flown at altitudes of 25 or 30 kilometers.

It appears likely that the rarefied fuel residual accompanying a midcourse vehicle will contain detectable amounts of some gaseous species. It will require further study to determine whether or not detectable numbers of atoms or molecules can result from outgassing or from sputtering processes. Author

N64-15324 Air Force Missile Test Center, Patrick AFB, Fla.
METEOROLOGICAL SUPPORT TO MISSILE TESTS
Peter E. Romo *In* AF Missile Test Center New Data Reduction Methods to Improve Range Data [1963] p 323–332 (See N64-15312 07-01)

The importance of meteorological data, especially wind, humidity, and air temperature data, prior to missile launch (while the missile is in an upright position) and after missile launch is discussed. J.E.T.

N64-15407* National Aeronautics and Space Administration, Washington, D.C.
PROBLEMS OF THE PHYSICS OF THE ATMOSPHERE, COLLECTION I
K. Ya. Kondrat'yev et al Feb. 1964 172 p refs Transl. into ENGLISH by Faraday Transl. of a book "Problemy Fiziki Atmosfery" Leningrad Univ. Press, 1963
(NASA TT-F-184) OTS: $3.00

CONTENTS:

1. ON THE POSSIBILITY OF THE DIRECT MEASUREMENT OF RADIATIVE DIVERGENCE K. Ya. Kondrat'yev p 1–25 refs (See N64-15408 07-21)

2. EXPERIMENTAL INVESTIGATIONS OF THE RADIATION BALANCE IN THE FREE ATMOSPHERE K. Ya. Kondrat'yev p 26–86 refs (See N64-15409 07-21)

3. A STUDY OF THE APPLICABILITY OF THE NORMAL LAW OF DISTRIBUTION FOR RANDOM QUANTITIES TO THE DERIVATION OF REGULAR CHARACTERISTICS OF THE WIND IN THE FREE ATMOSPHERE S. V. Solonin and Yu. M. Liberman p 87–105 refs (See N64-15410 07-21)

4. INFRARED ABSORPTION FUNCTIONS FOR THE MESOSPHERE AND UPPER STRATOSPHERE G. M. Shved and I. V. Tsaritsyna p 106–169 refs (See N64-15411 07-21)

N64-15408* National Aeronautics and Space Administration, Washington, D.C.
ON THE POSSIBILITY OF THE DIRECT MEASUREMENT OF RADIATIVE DIVERGENCE
K. Ya. Kondrat'yev *In its* Probl. of the Phys. of the Atmosphere Collection 1 Feb. 1964 p 1–25 refs (See N64-15407 07-21) OTS: $3.00

The problem of determining the radiative divergence and, in particular, its effect on the thermal regime and dynamics of the atmosphere, is discussed. In order to devise a method for direct measurement of the radiative divergence at different levels in the free atmosphere at night, Gergen proposed that the difference between the temperature of the air and that of a black ball might serve as a characteristic of its magnitude and sign. Gergen's theory and equations are discussed. R.T.K.

N64-15409* National Aeronautics and Space Administration, Washington, D.C.
EXPERIMENTAL INVESTIGATIONS OF THE RADIATION BALANCE IN THE FREE ATMOSPHERE
K. Ya. Kondrat'yev, G. N. Gayevskaya, and G. A. Nikol'skiy *In its* Probl. of the Phys. of the Atmosphere, Collection 1 Feb. 1964 p 26–86 refs (See N64-15407 07-21) OTS: $3.00

Investigations of the vertical profile of the radiation balance and its components, and the related problems of the radiation balance of the earth's surface atmosphere (the macroalbedo of the underlying surface, etc.) are discussed. Included are descriptions of the following: (1) the standard actinometric apparatus, (2) actinometric radiosondes, and (3) special apparatus for balloon and aircraft measurements—pyranometers, cloud photorecorders, radiometers, etc. R.T.K.

N64-15410* National Aeronautics and Space Administration, Washington, D.C.
A STUDY OF THE APPLICABILITY OF THE NORMAL LAW OF DISTRIBUTION FOR RANDOM QUANTITIES TO THE DERIVATION OF REGULAR CHARACTERISTICS OF THE WIND IN THE FREE ATMOSPHERE
S. V. Solonin and Yu. M. Liberman *In its* Probl. of the Phys. of the Atmosphere, Collection 1 Feb. 1964 p 87–105 refs (See N64-15407 07-21) OTS: $3.00

The object of radiosonde observations around Moscow and Sverdlovsk was to establish whether the normal law of distribution is applicable to the derivation of the climatic characteristics of the wind in the free atmosphere. The results of the radiosonde observations are presented. R.T.K.

N64-15411* National Aeronautics and Space Administration, Washington, D.C.
INFRARED ABSORPTION FUNCTIONS FOR THE MESOSPHERE AND UPPER STRATOSPHERE
G. M. Shved and I. V. Tsaritsyna *In its* Probl. of the Phys. of the Atmosphere, Collection 1 Feb. 1964 p 106–169 refs (See N64-15407 07-21) OTS: $3.00

Methods of calculating functions and derivatives (which jointly are called absorption characteristics for convenience) are discussed. These characteristics are calculated for particular regions in the infrared by reference to the same characteristics for individual lines having composite Lorenz–Doppler forms. The topics discussed include: (1) calculation of absorption characteristics, (2) the 15μ band of CO_2, (3) analysis of absorption characteristics, and (4) methods of computing the integrals. R.T.K.

N64-15485 Air Force Cambridge Research Labs., Bedford, Mass.
THE OCEAN BREEZE AND DRY GULCH DIFFUSION PROGRAMS, VOLUME I
Duane A. Haugen and James J. Fuquay (Hanford Atomic Prod. Operation), eds. Nov. 1963 249 p refs
(Contract AT(45-1)-1350)
(AFCRL-63-791(1); HW-78435; AD-428436)

CONTENTS:

1. DESIGN OF THE DIFFUSION EXPERIMENTS, PROJECTS OCEAN BREEZE AND DRY GULCH D. A. Haugen and J. J. Fuquay (Hanford Atomic Prod. Operation) p 1–19 refs (See N64-15486 07-21)

2. OCEAN BREEZE AND DRY GULCH DIFFUSION DATA C. L. Simpson, C. E. Elderkin, and P. W. Nickola (Hanford Atomic Prod. Operation) p 21–141 (See N64-15487 07-21)

3. OCEAN BREEZE AND DRY GULCH METEOROLOGICAL DATA J. Dwyer p 143–240 ref (See N64-15488 07-21)

N64-15486 Air Force Cambridge Research Labs., Bedford, Mass.
DESIGN OF THE DIFFUSION EXPERIMENTS, PROJECTS OCEAN BREEZE AND DRY GULCH

Duane A. Haugen and James J. Fuquay (Hanford Atomic Prod. Operation) *In its* Ocean Breeze and Dry Gulch Diffusion Programs, Vol. 1 Nov. 1963 p 1–19 refs (See N64-15485 07-21)

Data are given which represent a large sample of diffusion data from two geographical locations differing widely in terrain, vegetation, and climate. The experiments were conducted to sample significant differences in local circulation patterns at Cape Canaveral and Vandenburg Air Force Base, and to provide data for developing and testing diffusion prediction equations for operational use. The diffusion experiments are summarized according to a stability classification scheme loosely defined as very stable, moderately stable, moderately unstable, and very unstable. To classify each experiment, values of the mean temperature difference between 6 and 54 ft, denoted by the interval T, were used. Numerical limits of the interval T for the various categories are indicated. The primary value of the stability classification scheme is to emphasize the very high frequency of the experiments that are classified as moderately unstable. C.L.W.

N64-15487 Hanford Atomic Products Operation, Richland, Wash.

OCEAN BREEZE AND DRY GULCH DIFFUSION DATA

Charles L. Simpson, Charles E. Elderkin, and Paul W. Nickola *In* AFCRL Ocean Breeze and Dry Gulch Diffusion Programs, Vol. I Nov. 1963 p 21–141 (See N64-15485 07-21)

Summaries are presented of diffusion data that were obtained experimentally. A description is given of the assaying technique along with the Ocean Breeze diffusion data, the relationship between 5- and 15-ft Ocean Breeze exposure data, and the Dry Gulch diffusion data. C.L.W.

N64-15488 Air Force Cambridge Research Labs., Bedford, Mass.

OCEAN BREEZE AND DRY CULCH METEOROLOGICAL DATA

Joan Dwyer *In its* Ocean Breeze and Dry Gulch Diffusion Programs, Vol. I Nov. 1963 p 143–240 ref (See N64-15485 07-21)

Standard deviations of azimuth fluctuations were computed, and comparisons were made of frequency distributions of azimuth readings. Temperature differences and wind-speed data were studied; and rawindsonde data were collected and tabulated. C.L.W.

N64-15558* Dudley Observatory, Albany, N.Y.

PARTICLE SAMPLING FROM NOCTILUCENT CLOUDS

C. L. Hemenway, R. K. Soberman (AFCRL), and G. Witt (Stockholm U.) Repr. from Nature (London), v. 199, no. 4890, Jul. 20, 1963 p 269–270 refs

(NASA Grant NsG-155-61)

Particle sampling experiments have been conducted at the mesopause region of the atmosphere. The experiments utilized sounding rockets that were fired from the Kronogard range (68° N, 19° E) in northern Sweden during the summer of 1962. Two successful flights out of a total of four firings were achieved: one (August 11, 0140 G.M.T.) in the presence of noctilucent clouds and one (August 7, 0047 G.M.T.) when no such clouds could be visually observed from the ground and from aircraft. The Nike-Cajun rockets carried identical instruments, and the experimental conditions of the two successful flights were similar. The rocket flight and analysis are described. R.T.K.

N64-15618 Joint Publications Research Service, Washington, D.C.

RESEARCH AND DEVELOPMENT IN METEOROLOGY

14 Feb. 1964 46 p refs Transl. into ENGLISH of 3 articles from. Tr. Pervogo Vses. Nauchn. Meteoral. Saveshch. (Moscow), v. 4, 1962

(JPRS-23235; OTS-64-21563) OTS: $1.25

CONTENTS:

1. PRESENT-DAY METHODS IN CLIMATOGRAPHY AND THE PROSPECTS FOR THEIR DEVELOPMENT S. A. Sapozhnikova p 1–13 refs (See N64-15619 07-21)

2. SOVIET AND FOREIGN INVESTIGATIONS ON THE SUN-TROPOSPHERE PROBLEM B. M. Rubashev p 14–24 refs (See N64-15620 07-21)

3. ANALYSIS OF STATISTICAL HELICLIMATIC RELATIONSHIPS O. A. Drozdov and T. V. Pokrovskaya p 25–43 (See N64-15621 07-21)

N64-15619 Joint Publications Research Service, Washington, D.C.

PRESENT-DAY METHODS IN CLIMATOGRAPHY AND THE PROSPECTS FOR THEIR DEVELOPMENT

S. A. Sapozhnikova *In its* Res. and Develop. in Meteorology 14 Feb. 1964 p 1–13 refs (See N64-15618 07-21) OTS: $1.25

A method for computing maximum wind velocities is described. Computers have been used for processing data on the frequency of recurrence of minimum temperatures for 60 stations in the U.S.S.R. for the period 1936 to 1955. An analysis of these data is presented. R.T.K.

N64-15620 Joint Publications Research Service, Washington, D.C.

SOVIET AND FOREIGN INVESTIGATIONS ON THE SUN-TROPOSPHERE PROBLEM

B. M. Rubashev *In its* Res. and Develop. in Meteorology 14 Feb. 1964 p 14–24 refs (See N64-15618 07-21) OTS: $1.25

The following topics are discussed: (1) study of the occurrence of long-term cycles of solar activity as reflected in the climatic and hydrologic regime; (2) investigations of manifestations of the 11-, 22-, and 5- to 6-year solar cycles in climate and "macroweather"; (3) the 27-day rhythm in meteorological phenomena; (4) comparison of individual solar and meteorological phenomena; and (5) mechanisms of the relationship between solar activity and tropospheric phenomena. R.T.K.

N64-15621 Joint Publications Research Service, Washington, D.C.

ANALYSIS OF STATISTICAL HELIOCLIMATIC RELATIONSHIPS

O. A. Drozdov and T. V. Pokrovskaya *In its* Res. and Develop. in Meteorology 14 Feb. 1964 p 25–43 refs (See N64-15618 07-21) OTS: $1.25

A discussion is presented of the systematic problems involved in statistical investigations of heliogeophysical relationships, for the purpose of making recommendations concerning the study of the influence of solar activity on climate and weather. Certain errors occurring from an application of statistics to this problem are presented. R.T.K.

N64-15665 Science Council of Japan, Tokyo Japan Meteorological Agency

POST-IGC 1961 DATA ON UPPER AIR (RADIOSONDE) OBSERVATION: DEW POINT TEMPERATURE ATMOSPHERIC ELECTRICITY DURING WORLD METEOROLOGICAL INTERVALS

Mar. 1963 29 p refs

Data of dew-point temperature and atmospheric electricity in the upper air, observed by a radiosonde during World Meteorological Intervals in October 1961 and January 1962, are reported for the following stations: Sapporo, Tateno, Hachijojima, and Kagoshima. The data are presented in tabular form. R.T.K.

N64-15689 Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Meteorological Support Div.
ATMOSPHERIC STRUCTURE, WHITE SANDS MISSILE RANGE, NEW MEXICO. PART 2, TEMPERATURE, RELATIVE HUMIDITY, DEW POINT, STATION PRESSURE, DENSITY, CLOUDS, HYDROMETEORS, AND LITHOMETEORS
Marjorie McLardie Hoidale Jan. 1964 121 p refs
(ERDA-106; AD-429288)

A statistical analysis of exoteric meteorological data is presented for "A" Station, White Sands Missile Range, New Mexico. Author

N64-15807 Stanford U., Calif. Stanford Electronics Labs.
RADAR DETECTION OF IONIZED NITRIC OXIDE IN THE LOWER IONOSPHERE Final Report
Lawrence Colin Oct. 1963 106 p refs
(Contract AF 19(628)-233; Contract DASA-528-61)
(AFCRL-63-795; SEL-63-089; AD-430099)

High-resolution spectral analyses of radar echoes from field-aligned ionization in the lower ionosphere (E-region) uncovered a discrete component that apparently corresponds to the gyrofrequency of singly ionized nitric oxide (NO^+). No other discrete component was obvious from the data that were collected during nighttime hours. This radar sampling technique suggests that nitric oxide is the principal ionic species in the nighttime E-region, in agreement with a limited number of rocket-borne mass-spectrometer measurements. Analyses of radar data for the higher ionospheric F-region failed to uncover any discrete components. R.T.K.

N64-15846* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A GEOGRAPHICAL GRID FOR NIMBUS CLOUD PICTURES
Eugene M. Darling, Jr. Washington, NASA, Feb. 1964 17 p refs
(NASA TN D-2136) OTS: $0.50

This paper defines the geometrical, aesthetic, and utilitarian factors that must be considered in selecting a geographical reference grid for use with Nimbus cloud pictures. A particular grid is proposed and critically examined with respect to these factors. This grid is found to be acceptable once minor changes are made to compensate for image foreshortening. Author

N64-15930 Israel Program for Scientific Translation, Ltd., Jerusalem
CLOUD PHYSICS
A. Kh. Khrgian, ed. 1963 402 p refs Transl. into ENGLISH of the book "Fizika Oblakov" Leningrad GIMZ, 1961
(OTS-63-11141) OTS: $4.00

The book sums up modern research, both in the USSR and abroad, on the origin, development, and structure of clouds, their form, and their connection with synoptic conditions; modern methods of cloud study are also considered. It gives detailed data on the formation and properties of the microscopic elements of clouds—their position in space, motion, relation to the thermodynamic structure of the atmosphere, with its general circulation and cyclonic activity. Flight conditions in clouds are also examined. A chapter is devoted to a review of the available methods of artificial stimulation of clouds. Author

N64-16049 Army Missile Command, Redstone Arsenal, Ala. Redstone Scientific Information Center
THE EFFECTS OF MOUNTAINS ON AIR CURRENTS
Adriano Gazzola 7 Feb. 1964 26 p Transl. into ENGLISH from Riv. Meteorol. Aeron. (Italy), no. 1, 1963
(RSIC-131; AD-430424)

General facts are set forth about orographic waves, and a theoretical exposition is given. Included are characteristics of orographic waves, meteorological conditions favorable to the formation of atmospheric waves, and orographic clouds. The theoretical exposition includes the basic equation of hydrodynamics and models of the atmosphere with one or more layers. C.L.W.

22 NAVIGATION AND GUIDANCE

Includes autopilots; star tracking; inertial platforms; and air traffic control. *For related information see*: 06 Auxiliary Systems; 08 Communications; 09 Electronics; 10 Facilities, Research and Support; 15 Instrumentation and Photography; 20 Mathematics; and 29 Space Sciences.

N64-15078 Air Force Special Weapons Center, Kirtland AFB, N. Mex.
WIND COMPENSATION SOLUTION FOR UNGUIDED SPACE VEHICLES
Harvison Hunt Jan. 1964 24 p refs
(SWC-TDR-63-67; AD-426973)

A six-degree-of-freedom program is used as a basis for determining the required launch azimuth and elevation corrections. The results are then incorporated into a more rapid (but as accurate) solution adapted for use at the National Missile Ranges. Author

N64-15083 Adaptronics, Inc., Alexandria, Va.
FUNCTIONAL CAPABILITY OF NEUROMIME NETWORKS FOR USE IN ATTITUDE STABILIZATION SYSTEMS [Final Report, 15 Mar. 1962–15 Mar. 1963]
R. J. Lee and R. F. Snyder Wright-Patterson AFB, Ohio, AF Flight Dynamics Lab., Sep. 1963 244 p refs
(Contract AF 33(657)-8646)
(ASD-TDR-63-549; AD-429116)

An adaptive network illustrating the use of Neurotrons (neuromimes with the ability to learn both analog and logical functions) and Neurotron goals in an adaptive control system is presented, performance data being provided by computer simulation. The use of this system for satellite attitude stabilization is described. The simulated adaptive control system is composed of six Neurotrons, and is shown to function satisfactorily in the event of failure of a Neurotron. Computer flow diagrams and programing data for simulating a Neurotron, Neurotron networks, and goal systems on a digital computer are described. This report also includes mathematical development of a suitable way to digitize the analog Neurotron functions on the computer, a mathematical demonstration that

standard electrical equations for RC circuits can be applied to given Neurotron analog functions, and a hardware-oriented discussion of Neurotrons in terms of detailed block diagrams. Author

N64-15151 National Co., Inc., Malden, Mass.
RHO-RHO NAVIGATION SYSTEM STUDY, PHASE I Final Report
L. F. Fenton 18 Jul. 1963 116 p refs
(Contract FA-WA-4223)

Results are presented of the analysis of a Rho-Rho Navigation System with a high-accuracy frequency standard for use with aircraft intended for transoceanic flights in the North Atlantic area. Only the VLF (Omega) and LF (Loran-C) transmissions are considered practicable for this purpose; the LF (Loran-C) system has definite advantages and is recommended for use. Existing Loran-C stations across the Atlantic provide adequate coverage with sufficient navigational accuracy. The Rho-Rho Loran-C receiver can be made substantially simpler than the conventional Loran-C receiver. The cesium-beam frequency standards are preferable to other standards for this application because of their independence from calibration and better accuracy. The tie-in of the proposed Rho-Rho Navigation System with the existing aircraft doppler–radar system is explored in this study. Author

N64-15258 Minneapolis-Honeywell Regulator Co., Minn. Aeronautical Div.
THE PRESENT AND FUTURE ROLES OF STRAPPED-DOWN INERTIAL SYSTEMS
Jerry C. Powell *In* AF Systems Command Trans. of the 8th Symp. on Ballistic Missile and Space Technol., Vol. 2 [1963] p 161–178 ref (See N64-15251 07-01)

These roles are analyzed by a differential comparison of various mechanizations based on size, weight, power, reliability, and ease of maintenance. After definition of the system mechanization problem, inertial systems are divided into those classes using rate-sensing devices and those employing free gyros or other types of stable attitude reference. The computer vs gimbal tradeoff is then discussed for these classes, with emphasis on the strapped-down approach. Free-gyro mechanizations are specialized by considering only the electrically supported gyro (ESG). The impact of the electrically supported accelerometer (ESA) and laser rate sensor on future systems is considered. Author

N64-15259 Bell Aerosystems Co., Buffalo, N.Y. Avionics Div.
ATTITUDE CONTROL OF SATELLITES AND DETERMINATION OF ORBITAL PARAMETERS BY USE OF ACCELEROMETERS
H. Winter *In* AF Systems Command Trans. of the 8th Symp. on Ballistic Missile and Space Technol., Vol. 2 [1963] p 179–195 refs (See N64-15251 07-01)

A method of inertial instrumentation to obtain attitude error signals and those orbital parameters defining size and shape of the orbit is presented. This information is provided by the use of accurate linear accelerometers only; this is desirable due to the limited operating life of available gyros compared to the potential life of satellites. Two of many possible configurations are presented, and the accuracy associated with each method is analyzed. Author

N64-15318 Air Force Missile Development Center, Holloman AFB, N. Mex.
THE ERRORS OF INERTIAL GUIDANCE SYSTEMS
Martin G. Jaenke *In* AF Missile Test Center New Data Reduction Methods to Improve Range Data [1963] p 145–181 (See N64-15312 07-01)

Rudimentary background information in guidance techniques and a basic analysis of errors encountered in the evaluation of guidance system errors are presented. Major topics include: (1) definition of the errors of inertial guidance systems; (2) determination of the errors of inertial guidance systems, including editing processes and linear operations; and (3) guidance systems as calibrators for range instrumentation systems. J.E.T.

N64-15478 General Electric Co., Philadelphia, Pa. Missile and Space Vehicle Dept.
INFRARED HORIZON SCANNING FOR ATTITUDE CONTROL
J. T. La Van *In* AGARD, Paris Light and Heat Sensing 1963 p 411–435 refs (See N64-15452 07-23)

The system that is described is a scheme to detect the infrared interface between a planet and its surrounding space. It consists of an optical arrangement that focuses the radiated power from the planet into an infrared sensitive detector. The optics are mounted on a moving assembly that scans 360 degrees/cycle at x cycles. Therefore, whenever the optical line of sight crosses an object that is warmer than space, a pulse of flux is seen by the detector. The sensitive element in the detector is a material that is a conductor of electrical current. When the temperature of this material is changed by radiation, the resistance of it changes proportionally to the temperature change. Hence, a potential is generated that is a function of the received radiation. Besides the radiation source, the working distance, the distance from the sun and the angle subtended by the disc as seen by the sensor, the physical size of the detector, and the optical field of view are important. The parameters must be chosen to satisfy the desired requirements as to signal-to-noise ratio, resolution, and field of view. Author

N64-15497 Minneapolis-Honeywell Regulator Co., Minn. Aeronautical Div.
STUDY OF PILOT-CONTROLLER INTEGRATION FOR EMERGENCY CONDITIONS
G. Cole, M. Bender, R. Shoquist, R. Santella, D. Lovinger, and O. H. Lindquist Wright-Patterson AFB, Ohio. Flight Control Div., [1964] 191 p refs
(Contract AF 33(657)-7601)
(RTD-TDR-63-4092; AD-428320)

The objective of this program was to develop a design concept that will minimize catastrophic flight control failures through appropriate pilot-controller integration. This report describes a systematic procedure composed of techniques within the field of flight control design, reliability, and human factors that yields a practical approach for effective design of an integrated pilot-controller system. Application of the procedure was made to an advanced vehicle mission phase as an aid to the study group in determining practicality of the approach. Author

N64-15727 Aerospace Corp., El Segundo, Calif. Systems Research and Planning Div.
BUBBLE LEVELS AS ATTITUDE SENSORS IN SATELLITES
A. S. Gutman 15 Jan. 1964 37 p refs
(Contract AF 04(695)-269)
(SSD-TDR-63-373; TDR-269(4513-10)-3; AD-430199)

A bubble level is investigated as a means of sensing the local vertical of an attitude-stabilized satellite. Such an instrument acts in a manner very similar to a pendulum with low

friction. The time constant of the instrument is calculated, and errors of the local vertical due to dynamic accelerations are analyzed. It is found that the primary errors in an attitude-stabilized satellite are caused by angular accelerations. An angular accelerometer is described that can be used in conjunction with the bubble level to calculate the direction of the local vertical instantaneously. Without this angular accelerometer, the bubble level can be used to indicate the long-term average attitude of the satellite. Author

N64-15748 Pickard and Burns Electronics, Waltham, Mass.
ATOMIC OSCILLATOR DEVICE FOR NAVIGATION-GUIDANCE Interim Engineering Report No. 1
R. H. Woodward, L. Johnson, R. Sanborn, I. Felch, G. Taylor, and R. L. Smith 30 Oct. 1963 167 p refs
(Contract AF 33(657)-11384)
(P&B-859; ASD-TDR-63-1; AD-429859) OTS: $12.00

The first interim report covers the preparation of specifications and designs for the major subassemblies for a pair of experimental models of the ultrastable atomic oscillator device for navigation–guidance. The purpose of the first pair of experimental models is to demonstrate a stability of ±5 parts in 10^{14} over the specified temperature range of −54° to +71° C and over an input voltage range of ±20 percent. Later models are designed to meet the requirements for size (1/2 ft^3), weight (40 lb), and power consumption (50 w). Author

N64-15872* ITT Federal Labs., Fort Wayne, Ind. Astrionics Center
ORBITAL LAUNCH ERROR ANALYSIS AND DEVELOPMENT OF A STAR SENSING SYSTEM SUITABLE FOR INERTIAL PLATFORM ALIGNMENT, VOLUME II
29 May 1963 49 p
(NASA Contract NAS8-5001)
NASA CR-55732; *Its* Serial No. 3275, Vol. 2) OTS: $4.60 ph, $1.67 mf

This report deals with a breadboard of an instrument suitable for use as an attitude-sensing component of an inertial-platform-alignment system. The physical and performance characteristics of the developed breadboard are summarized, and improvements currently available are discussed. Also discussed are the physical description, the theory of operation, and the electrical alignment procedures of the breadboard system, as well as results obtained in laboratory tests performed with the breadboard. I.v.L.

N64-16055 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ON THE MOVEMENTS OF A STATICALLY BALANCED GYROSCOPE IN A CARDIAN JOINT, MOUNTED ON A VIBRATING BASE
A. M. Lestev 16 Oct. 1962 12 p refs Transl into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii Priborostr., v. 5, no. 1, 1962 p 82–88
(FTD-TT-62-1280/1+2; AD-292193)

The effect of balancing on the movement of a gyroscope mounted on a vibrating base is considered. A system of differential equations is formulated to describe the equations of motion of this gyroscopic system relative to the stationary system of coordinates. R.T.K.

23 PHYSICS, GENERAL

Includes acoustics; cyrogenics; and optics. *For astrophysics see*: 05 Astronomy and Astrophysics. *For related information see*: 12 Geophysics; 29 Space Sciences; 24 Physics, Plasma; and 25 Physics, Solid-State.

N64-15001 California Inst. of Tech., Pasadena
QUANTITATIVE SPECTROSCOPIC STUDIES ON WATER VAPOR AND LIQUID WATER
S. S. Penner Oct. 1963 45 p refs
(Contract Nonr-220(45))
(Tech. Rept. 43; AD-427119)

CONTENTS:

1. MEASUREMENTS OF INFRARED ABSORPTION BY WATER VAPOR AT TEMPERATURES UP TO 1000° K R. Goldstein p 1–19 refs (See N64-15002 07-23)

2. TRANSMISSION OF INFRARED RADIATION THROUGH LIQUID WATER AND THROUGH WATER VAPOR NEAR SATURATION R. Goldstein and S. S. Penner p 20-23 refs (See N64-15003 07-23)

3. THE NEAR INFRARED ABSORPTION OF LIQUID WATER AT TEMPERATURES BETWEEN 27 AND 209° C R. Goldstein p 24–37 refs (See N64-15004 07-23)

4. APPROXIMATE SPECTRAL EMISSIVITY CALCULATIONS FOR WATER VAPOR AT ELEVATED TEMPERATURES R. Goldstein and L. D. Gray p 38–43 refs (See N64-15005 07-23)

N64-15002 California Inst. of Tech., Pasadena
MEASUREMENTS OF INFRARED ABSORPTION BY WATER VAPOR AT TEMPERATURES UP TO 1000°K
R. Goldstein *In its* Quant. Spectroscopic Studies on Water Vapor and Liquid Water Oct. 1963 p 1–19 refs (See N64-15001 07-23)

The integrated intensities and spectral absorption coefficients of water vapor in the 1.38μ-, 1.87μ-, 2.7μ-, and 6.3μ-spectral regions have been measured at temperatures up to 1,000° K. The experiments were performed in a specially designed, high-temperature absorption cell that utilized self-broadening to remove the rotational fine structure. Author

N64-15003 California Inst. of Tech., Pasadena
TRANSMISSION OF INFRARED RADIATION THROUGH LIQUID WATER AND THROUGH WATER VAPOR NEAR SATURATION
R. Goldstein and S. S. Penner *In its* Quant. Spectroscopic Studies on Water Vapor and Liquid Water Oct. 1963 p 20-23 refs (See N64-15001 07-23)

Experimental measurements are performed on the transmission of infrared radiation through water and through water vapor near the limits of saturation and on the change of absorption of water with increasing temperature. The vapor phase, at a pressure that differs from saturation conditions by a microscopic amount, has a transmission spectrum that is noticeably different from that of the liquid phase. A rather abrupt change is observed in transmission just before saturation conditions are reached. As condensation occurs, the remaining rotational structure disappears; the absorption peaks are notably shifted and the absorption coefficients are markedly increased in some spectral regions and decreased in others. In experiments on the change of absorption of water with increasing temperature, it is found that, as the temperature of the water is increased, the absorption spectra closely approximate the absorption spectra of water vapor. C.L.

N64-15004 California Inst. of Tech., Pasadena
THE NEAR INFRARED ABSORPTION OF LIQUID WATER AT TEMPERATURES BETWEEN 27 AND 209°C
R. Goldstein *In its* Quant. Spectroscopic Studies on Water Vapor and Liquid Water Oct. 1963 p 24–37 refs (See N64-15001 07-23)

The spectral absorption coefficients of liquid water have been measured in the spectral regions from 2,200 to 3,000 cm^{-1} and from 3,700 to 7,600 cm^{-1} at temperatures of 27°, 89°, 159°, and 209°C. In addition, the integrated intensities for the spectral regions from 4,600 to 5,900 cm^{-1} and from 5,900 to 7,600 cm^{-1} have been determined at each of the specified temperatures. Author

N64-15005 California Inst. of Tech., Pasadena
APPROXIMATE SPECTRAL EMISSIVITY CALCULATIONS FOR WATER VAPOR AT ELEVATED TEMPERATURES
R. Goldstein and L. D. Gray *In its* Quant. Spectroscopic Studies on Water Vapor and Liquid Water Oct. 1963 p 38–43 refs (See N64-15001 07-23)

Using the experimental integrated intensities for a region at 200° C and the estimated relative intensities for the vibration-rotation bands in a region, the spectral absorption coefficients are calculated for all the experimental conditions described. In the calculations, the integrated intensity is assumed to vary inversely with temperature. Comparisons are made of theoretical curves with experimental data that indicate that the theoretical equation provides a crude fit to the data. The theoretical band curves are most obviously deficient in that they cannot account for the presence of the Q-branch in the perpendicular bands and they fail to include the multiplicity of combination bands, which contribute in a given spectral region. C.L.W.

N64-15012 Massachusetts Inst. of Tech., Cambridge Lab for Insulation Research
MOLECULAR ORBITALS AND ELECTRON-TRANSFER SPECTRA IN RUTILE
Carl W. Nelson and Arthur Linz *In its* Mol. Orbitals and Electron-Transfer Spectra in Rutile Dec. 1963 8 p refs (See N64-15011 07-01)
(Contract AF 33(616)-8353)
(MIT-TR-184)

Specular-reflectance measurements on single crystals and absorption measurements on thin films of rutile were made in order to investigate its electronic transitions in the ultraviolet region. A theory is presented for the understanding of these transitions. Author

N64-15066 ARO, Inc., Arnold Air Force Station, Tenn.
TEMPERATURE EFFECTS ON THE CAPTURE COEFFICIENT OF CO_2
J. P. Dawson and J. D. Haygood Arnold Engr. Develop. Center, Jan. 1964 36 p refs
(Contract AF 40(600)-1000)
(AEDC-TDR-63-251; AD-428497)

Results are presented for the second phase of an experimental program designed to study the effects of gas and cryosurface temperatures on the capture coefficients in cryopumping. Experimental pumping speeds and capture coefficients were obtained for 195°, 300°, and 400° K carbon dioxide on a spherical cryosurface with temperatures ranging from 12° to 77° K. These measurements cover a pressure range of 10^{-8} to 10^{-5} mm Hg. Based on a potential well-energy barrier molecular model, an empirical equation is developed and found to correlate well with the experimental results. Author

N64-15067 Little (Arthur D.), Inc., Cambridge, Mass.
MEASUREMENT OF OPTICAL CONSTANTS AT HIGH TEMPERATURES Final Report
W. S. Martin, E. M. Cuchane, and H. H. Blau, Jr. Dec. 10, 1963 32 p refs
(Contract AF 19(604)-7485)
(AFCRL-63-547; AD-428932)

This report describes a new method for accurately measuring the optical constants of metals at high temperatures. Data obtained using this method to study single crystals of tungsten, molybdenum, and columbium are presented and discussed. Author

N64-15082 Toronto U. (Canada) Inst. of Aerophysics
PRESSURE MEASUREMENT IN TRANSITION AND FREE MOLECULAR FLOWS USING ORIFICE PROBES Final Technical Report
J. C. Lafrance Wright-Patterson AFB, Ohio, Aerospace Res. Labs., Dec. 1963
(Contract AF 33(616)-6990)
(ARL-63-222; AD-428157)

When bodies travel in a gas so rarefied that the mean-free-path of the molecules is much larger than any of the dimensions of the body, the aerodynamic properties of the body can be calculated using kinetic theory, ignoring the collision between the molecules that have struck the body and those directed toward it. At slightly higher densities such collisions start to become of importance, and deviations from the free-molecular theoretical results will occur. This report describes a series of experiments performed in a rotating arm apparatus to study the deviations from free-molecular flow that occur at low subsonic speeds. The specific criterion used in these tests was the pressure measured by an orifice probe in the walls of cylinders and flat plates of rectangular and circular shape that were perpendicular to the flow direction. It was found that the deviations from free-molecular flow depend on both dimensions perpendicular to the flow in relation to the mean-free-path and on the speed ratio. Author

N64-15086 Southwestern Coll., Memphis, Tenn.
APPARATUS FOR STUDYING NEAR IR RADIATION FROM HIGH ALTITUDE CHEMICAL RELEASES
J. H. Taylor *In its* Time-Dependent Infrared Studies Dec. 1963 p 5–122 refs (See N64-15085 07-01)

A 31-in. diam. (f/2) radiometer and PbS detector were used to study near infrared radiation from chemical releases during Project Firefly. Author

N64-15098 Texas U., Austin Electrical Engineering Research Lab.
THE STATIC AND DYNAMIC TEMPERATURE CHARACTERISTICS OF THE OXYGEN LINE AT THE 2.5 MM WAVELENGTH Quarterly Engineering Report No. 7, 1 Nov. 1963-31 Jan. 1964
Eddie H. Young, Jr. Wright-Patterson AFB, Ohio, Aeron. System Div., [1964] 52 p refs
(Contract AF 33(657)-8716)
(AD-428845)

The microwave interaction with the O_2 gas is found to account for most of the attenuation in the atmosphere. Investigations are carried out to study the static and dynamic characteristics of the attenuation of pure oxygen near the line at 118.75 Gc. The attenuation of oxygen is measured in a closed cell for different temperatures at 117, 118, and 118.4 Gc. Also, the attenuation of microwave energy under dynamic

changes of pressure and temperature is measured. The experimental values are compared with the theory and are found to be within experimental error. Author

N64-15112 Navy Electronics Lab., San Diego, Calif.
CONTROL OF ELEMENT VELOCITY DISTRIBUTIONS IN SONAR PROJECTOR ARRAYS
D. L. Carson, G. E. Martin, G. W. Benthien, and J. S. Hickman In ONR Solution to Navy Probl. through Advanced Technol. [1963] p 158–174 refs (See N64-15101 07-01) OTS: $5.00

For an important class of arrays, those whose elements are closely packed and whose head dimensions are small compared to λ (the wavelength of sound in water at operating frequency), the proportionality factor is not likely to be the same for each radiator of the array but changes from radiator to radiator across the array. This problem is discussed, as is an investigation of the reasons for the reaction. Corrective measures are recommended. Attention is centered on piezoelectric radiators, but the principles involved apply to all radiator types. R.T.K.

N64-15119 Pacific Missile Range, Point Mugu, Calif.
PROPAGATION OF HYDROMAGNETIC WAVES IN AN ATMOSPHERE OF ARBITRARY ELECTRIC CONDUCTIVITY
H. F. Ludloff In ONR Solution to Navy Probl. through Advanced Technol. [1963] p 286–294 refs (See N64-15101 07-01) OTS: $5.00

The interaction of time-dependent electromagnetic fields (electromagnetic waves) with an atmosphere of arbitrary electric conductivity σ was investigated over the whole range of $\sigma(\sigma = 0 \ldots \infty)$; the range of small σ seems most important for terrestrial applications. Results of the investigation indicate that electromagnetic waves, beamed into the upper atmosphere, where ionization and conductivity cannot be neglected, produce fluid vibrations that destabilize the flow pattern around incoming missiles. If the electromagnetic beams are sufficiently strong, the amplitudes of the air vibrations are appreciable. R.T.K.

N64-15121 Aerospace Corp., El Segundo, Calif. Electronics Research Lab.
EXCHANGE INTERACTION BETWEEN PAIRS OF CHROMIUM IONS IN RUBY Semiannual Report, 1 Jan.-30 Jun. 1963
P. Kisliuk and W. F. Krupke 18 Nov. 1963 37 p refs
(Contract AF 04(695)-169)
(SSD-TDR-63-417; TDR-169(3250-24) TN-2; AD-429197)

The temperature dependence of the absorption of the spectral lines due to pairs of chromium ions in concentrated ruby at 7,009 A and 7,041 A is fitted to theory by assuming isotropic exchange coupling. Other frequencies predicted from the parameters thus determined are identified in the observed spectrum. Higher states are identified by the excitation spectrum and the spacings already known from the identification of the lower levels. To a closer approximation, it is found that the ground-state splitting can be fitted within the experimental error using isotropic exchange if a biquadratic term is included, in addition to the usual quadratic term. Furthermore, the ratio of the coefficients of these terms is of the same order as that found in other materials and predicted by theory. The excited states, however, do not appear to fit a theory based on isotropic exchange coupling as the sole perturbation. Author

N64-15124 Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
ON JET FORMATION IN A MOLECULAR FLOW
P. Clausing 20 Dec. 1963 11 p refs Transl. into ENGLISH from Z. Physik (Berlin), v. 66, 1930 p 471–476
(RSIC-114; AD-428325)

Formulas are given for the spatial distribution of molecules that flow into an empty vessel though a short tube. R.T.K.

N64-15173* Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
NOISE REDUCTION OF RECTANGULAR ENCLOSURES WITH ONE FLEXIBLE WALL
Richard H. Lyon Repr. from J. Acoust. Soc. Am., v. 35, no. 11, Nov. 1963 p 1791–1797 refs
(NASA Contract NASw-788)

The noise reduction produced by a small rigid enclosure with one flexible wall is computed. It is assumed that the critical frequency of the wall lies above the first acoustic resonance of the enclosure. The noise reduction is computed for very low frequencies where both wall and enclosed volume are stiffness-controlled, for frequencies where the wall is resonant and the volume is stiff, and for frequencies where both the wall and the acoustic space have resonant behavior. In the last case, a comparison is made with the usual noise-reduction calculations based on forced wave-transmission loss. The noise reduction computed in this paper turns out to be less than the value computed by that more "classical" approach. Author

N64-15178 Bettis Atomic Power Lab., Pittsburgh, Pa.
RECAP-1, A MONTE CARLO PROGRAM FOR ESTIMATING EPITHERMAL CAPTURE RATES IN SLABS Interim Memorandum
N. R. Candelore and R. C. Gast Oct. 1963 40 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-TM-407) OTS: $1.00

The calculation of epithermal capture rates in a repeating array of slabs by Monte Carlo is described in a program for the Philco 2000. Doppler-broadened resonance cross sections for as many as five nuclides (each having at most 50 resonances in the resolved energy range) and nuclear parameters for five non-resonance nuclides with 1/v absorption properties and constant scattering make up the cross-section library. Each slab may contain any or all of the above 10 isotopes, thus permitting studies of resonance interference effects. The resonance capture probabilities are calculated using the Σ_a/Σ_T estimator. Smooth and resonance captures are edited separately. Author

N64-15198 Aerojet-General Nucleonics, San Ramon, Calif.
ARMY GAS-COOLED REACTOR SYSTEMS PROGRAM Quarterly Progress Report, 1 Jul.- 30 Sep. 1963
R. H. Chesworth 15 Nov. 1963 63 p refs
(Contract AT(10-1)-880)
(IDO-28617) OTS: $1.50

The design of turbine blades for the CSN-1 was revised to prevent the cracking reported earlier, and fabrication of replacement parts was initiated. The TCS-670A turbine compressor set performed satisfactorily during open-cycle test and was installed on the power conversion skid for closed-cycle tests. A hot cell examination of the IB-17R-1 (instrumented ML-1-II prototype test element) was initiated. No unanticipated conditions were observed. Irradiation of the IB-17R-2 and -3 test elements in the GETR loop continued without incident. Author

N64-15200 Hanford Atomic Products Operation, Richland, Wash. Physics and Instruments Lab.
PHYSICS RESEARCH QUARTERLY REPORT, JULY, AUGUST, SEPTEMBER, 1963

F. G. Dawson, Jr., J. L. Carter, W. A. Reardson, R. S. Paul, E. D. Clayton et al 15 Oct. 1963 91 p refs
(Contract AT(45-1)-1350)
(HW-79054) OTS: $2.25

This report contains the following papers: (1) "The Modified Heavy Gas Equation and Graphite Moderated Systems"; (2) "The Scattering Law for Water—Part-II"; (3) "Delayed Neutron Parameters and Reactivity Measurements in the Plutonium Recycle Critical Facility"; (4) "Neutron Spectrum Measurements in the Plutonium Recycle Critical Facility"; (5) "Subcritical Measurements with 2.0 wt% Pu-Al Rods in Light Water"; (6) "The High-Temperature Lattice Test Reactor"; (7) "Critical Experiments with PuO_2-Polystyrene Compacts"; (8) "Three Calculations Related to the Measurement of Total Cross Sections"; and (9) "The Development of a Spectrometer for Slow-Neutron Inelastic Scattering by Time-of-Flight." I.v.L.

N64-15241 California U., Berkeley Lawrence Radiation Lab.
EVIDENCE FOR A NEW REGION OF DEFORMATION WITH LESS THAN EIGHTY-TWO NEUTRONS
Richard N. Chanda (Ph.D. Thesis) 29 Apr. 1963 84 p refs
(Contract W-7405-eng-48)
(UCRL-10798) OTS: $2.00

Experimental evidence for a new region of nuclear deformation in the neutron-deficient rare earths has been obtained through the use of reactions of the type (heavy ion, xn) leading to several new neutron-deficient lanthanum isotopes. Three previously unreported lanthanum isotopes have been identified: La^{126}, La^{128}, and La^{130}, with half-lives of 1.0 ±0.3, 6.1 ±0.6, and 9.0 ±1.0 min, respectively. The decays of these odd–odd lanthanum isotopes have been investigated, using γ–γ coincidence spectroscopy, and partial-level schemes are proposed for the respective even–even daughter barium isotopes. Systematics of deformed nuclei are discussed in general, and the barium nuclei are compared with other deformed nuclei from other regions of deformation. Evidence for the existence of deformation is derived both from the energies of the first excited states and from the ratios of energies expected and observed in rotational bands in even–even nuclei. Author

N64-15250 Oak Ridge National Lab., Tenn.
CUMULATIVE BIBLIOGRAPHY OF LITERATURE EXAMINED BY THE RADIATION SHIELDING INFORMATION CENTER, SEPTEMBER 1963
S. K. Penny, D. K. Trubey, L. Jung, and M. B. Emmett 7 Jan. 1964 312 p refs
(ORNL-RSIC-2)

The list of subject categories includes basic nuclear and atomic information, radiation effects, transport theory, experimental techniques, results of radiation transport calculations and experiments for simple geometries, shield-design techniques, and shielding materials. An author index is given. R.L.K.

N64-15274* Chicago U., Ill. Inst. for the Study of Metals
MECHANISMS FOR SUPERCONDUCTIVITY IN THE TRANSITION METALS
James W. Garland, Jr. Repr. from Phys. Rev. Ltr., v. 11, no. 3, 1 Aug. 1963 p 111–114 refs
(NASA Grant NsG-352)

Recent papers on superconductivity in the transition metals suggest almost unanimously that superconductivity does not arise primarily from the electron–phonon interaction. These papers cite four categories of experimental evidence: (1) the absence of considerable reduction of the isotope effect in the superconducting transition metals; (2) the pressure dependence of the transition temperature T_c; (3) observations relating T_c to position in the periodic table and to N(0), the total density of the states at the Fermi surface; and (4) impurity effects, especially those due to magnetic impurities. It is demonstrated that this this experimental evidence is consistent with the Bardeen, Cooper, and Schrieffer theory and supports the idea of phonon-induced superconductivity. (According to the Bardeen, Cooper, and Schrieffer theory, superconductivity arises from an essentially attractive interaction between Landau quasi-particles.) R.T.K.

N64-15275* Maryland U., College Park
INTERACTION ENERGIES AND TRANSPORT COEFFICIENTS OF Li+H AND O+H GAS MIXTURES AT HIGH TEMPERATURES
Paul H. Krupenie (NBS), Edward A. Mason, and Joseph T. Vanderslice Repr. from J. Chem. Phys., v. 39, no. 10, 15 Nov. 1963 p 2399–2408 refs
(NASA Grant NsG-5-59)

Accurate potential energy curves for the $X^1\Sigma_g^+$, $A^1\Sigma_u^+$, $B^1\Pi_u$, and $C^1\Pi_u$ states of the Li_2 molecule are calculated from observed spectroscopic data by the method of Rydberg–Klein–Rees (RKR), and compared with previous quantum-mechanical calculations. Long-range attractive potentials are estimated by extrapolation of functions fitted to the RKR ground-state curves of Li_2, LiH, and OH. From these, the repulsive potentials derivable from interacting ground-state atoms are estimated semiempirically. Collision integrals are computed from the potentials, and transport coefficients of the gaseous systems Li+Li, Li+H, and O+H are calculated for temperatures of 1000° to 10,000° K. A surprising result is the extraordinarily large values of the collision integrals for Li+Li (and Li+H) interactions, which result in unexpectedly small values of diffusion coefficient, viscosity, and thermal conductivity. For traces of Li in Li+H mixtures at low temperature, the thermal diffusion factor is very large. Various approximate formulas for viscosity and thermal conductivity of mixtures are seen to give poor agreement with exact calculations for the systems considered. Author

N64-15294 Mound Lab., Miamisburg, Ohio
PROCESSING AND PROPERTIES OF POLONIUM-208
G. L. Fox, G. D. Nelson, and W. H. Powers 17 Jan. 1964 28 p refs
(Contract AT(33-1)-GEN-53)
(MLM-914) OTS: $0.50

A total of 9.243 curies Po^{208} was produced by 19-Mev and 23-Mev proton irradiation of bismuth, and purified. Polonium produced by a 19-Mev beam contained 15.5 to 20.5 wt % Po^{209}; by a 23-Mev beam, an average of 9 wt %. Submicrocurie to multicurie quantities of polonium in massive amounts of bismuth were concentrated with up to 98% recovery. A tellurium carrier process for purifying microcurie quantities of polonium recovered about 70%; a noncarrier stannous chloride process for purifying millicurie to multicurie quantities recovered 88%. Gamma to alpha intensity ratios of 10.3×10^{-5} and 8.56×10^{-5}, respectively, were determined for purified polonium prepared by irradiation with 19- and 23-Mev protons. Gamma radiations associated with Po^{208} and Po^{209} (0.89, 0.58, 0.27, and 0.07 Mev) were assumed to be from Po^{209}. Lead and iron impurities in the irradiated bismuth formed gamma-emitters Bi^{205}, Bi^{208}, and Co^{56}. The iron in the aluminum backing produced Co^{56}. Po^{208} neutron sources meeting Mound Laboratory specifications for Po^{210} neutron sources were prepared. The range of Po^{208} alpha particles was determined to be 3.66 cm in air at 15°C and one atmosphere. The half-life of the alpha radiation is 2.89 ±0.01 years. Author

N64-15301* Rochester U., N.Y. Inst. of Optics
A NOTE ON THE TESTING OF HOMOGENEITY OF LARGE-APERTURE PARALLEL PLATES OF GLASS
M. V. R. K. Murty Repr. from Appl. Opt., v. 2, Dec. 1963 p 1337–1339
(NASA Contract NASr-14)

Methods are suggested for testing homogeneity of thick parallel glass plates. One method suggests an arrangement using a well-corrected lens and a plane mirror. A second method suggests using an off-axis paraboloidal mirror and a plane mirror, and a third method suggests an arrangement for testing homogeneity using a paraboloidal mirror on axis and a plane mirror. A final arrangement uses a single spherical mirror. C.L.W.

N64-15309* Chicago U., Ill.
ISOTOPE EFFECT IN SUPERCONDUCTIVITY
James W. Garland, Jr. Repr. from Phys. Rev. Ltr., v. 11, no. 5, 1 Aug. 1963 p 114–119 refs
(NASA Grant NsG-352)

The transition temperature T_c of a superconductor is taken to depend upon the average atomic mass M of its constituents as follows: $T_c \propto M^{-\zeta} = M^{-0.5(1-\Omega)}$. Calculated values of ζ are presented that agree with experimental results and show that the observed qualitative difference between the reduced isotope effect ($\zeta \geq 0.3$) of the transition metals and the nearly complete isotope effect ($\zeta \sim 0.1$) of the simple metals (metals other than transition metals, rare earths, or acrinides) follows from elementary ideas of band structure. An isotropic free-electron model was assumed for the simple metals, and a two-band model, consisting of nearly free electronic states orthogonalized to tightly bound states, was assumed for the transition metals. P.V.E.

N64-15311* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A RECIPROCITY THEOREM FOR THE INTERACTION OF ELECTROMAGNETIC PLANE WAVES WITH A ONE-DIMENSIONAL INHOMOGENEOUS SLAB
C. T. Swift Repr. from Proc. of the IEEE, v. 51, no. 9, Sept. 1963 2 p refs
(NASA RP-127)

Equations are derived that demonstrate that, at a given frequency, angle of incidence and polarization, the transmission of electromagnetic waves through a one-dimensional inhomogeneous plasma is independent of the direction of transmission. The reflection coefficients, in general, do not necessarily conform to a reciprocity relationship. R.T.K.

N64-15328 California U., Livermore Lawrence Radiation Lab.
TRANSIENT REACTOR AEROTHERMODYNAMICS
Howard C. Rodean (Ling-Temco-Vought, Inc.) 18 Nov. 1963 53 p refs
(Contract W-7405-eng-48)
(UCRL-7606)

The transient aerothermodynamic processes in a gas-cooled reactor are described in a simplified manner to illustrate some of the fundamental physical phenomena involved, to provide some approximate but useful methods of analysis, and to aid in the understanding and use of more complex computer solutions. The transient heat balance equation for an element of a single reactor channel is derived in terms of aerothermodynamic time constants, and typical analytic solutions for transients are presented. This equation is used in generating the time-dependent equation for the channel exhaust gas temperature. The single-channel analysis is extended to multiple channels. A method for determining the approximate transient temperature envelopes for various reactor components is presented. The effects of aerodynamic and thermal coupling between different reactor channels are illustrated. Some of the simplifying assumptions are investigated with respect to the conditions under which they are valid. Author

N64-15331* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
AXIAL AND RADIAL MAGNETIC FIELDS OF THICK, FINITE-LENGTH SOLENOIDS
Gerald V. Brown, Lawrence Flax, Eugene C. Itean, and James C. Laurence Washington, NASA, Dec. 1963 100 p refs
(NASA TR R-170) OTS: $2.25

The axial and radial components of the magnetic field intensity of thick, finite-length solenoids were derived, and numerical results were computed for several combinations of coil thickness and length for two different current-density distributions. The triple integrals giving the field values were integrated twice analytically; the third integration was done numerically on electronic computers. The data are presented in tables and in sample graphs. Author

N64-15362 Vanderbilt U., Nashville, Tenn.
INTERPRETATION OF NEAR AND VACUUM ULTRAVIOLET BAND SPECTRA Quarterly Technical Progress Report No. 2, 1 Sep.-30 Nov. 1963
K. Keith Innes Nov. 1963 3 p
(ARPA Order 40; Contract DA-ARO(D)-31-124-G456)
(AD-427906)

Progress is summarized as follows: (1) The red-degraded bands of the 5,450 A emission from discharges through BF_3 vapor arise from the BO_2 molecule. (2) The only absorption observed when MgS and ZnS were heated together to 900°C in a 1-meter absorption cell was that of atomic Mg and the molecule SiS. (3) The hollow-cathode discharge with the visible AlO bands was monitored, and long exposures between 1,200 A and 2,000 A were made. The spectrum was dominated by atomic lines. (4) The source developed for study of the green emission by BO_2 molecules has been found to give strong infrared emission, which is suggestive of BO_2 molecules in two electronic states. (5) The spectrum between 1,200 A and 2,000 A of the BO_2 molecule is dominated by bands of the BO and BF molecules. (6) A detailed study of the source developed for investigating the green emission by BO_2 was conducted using 96% B^{10} and 97% B^{11} in the KBF_4 and B_2O_3 samples. Some hitherto unidentified bands have been photographed; these are violet degraded and very closely spaced. The isotope effect shows that there are two boron atoms in the emitting molecule, and the moment of inertia is as that expected for the OBBO molecule. I.v.L

N64-15366 General Dynamics/Fort Worth, Tex. Nuclear Aerospace Research Facility
MEASURMENT OF RADIATION HEATING IN AEROSPACE STRUCTURAL MATERIALS
B. E. Morris, N. D. King, and H. G. Carter 16 Sep. 1963 62 p refs
(Contract AF 33(657)-7201)
(NARF-63-8T; FZK-9-187; AD-421046)

Heating measurements were obtained throughout the following five configurations: (1) 4 inches of T-61 weldable aluminum, (2) 4 inches of Inconel-X, (3) 4 inches of 6% borated polyethylene, (4) 4 inches of 6% borated polyethylene preceded by 1 inch of lead, and (5) 4 inches of 6% borated polyethylene

preceded by 1/4 inch of boral preceded by 1 inch of lead. Gamma-ray and neutron dosimetry measurements were taken by means of a 4-cc ion chamber, gamma-ray chemical dosimeters, sulfur pellets, and gold foils. Heating rates were calculated for configurations 1 through 4, and both measured and calculated data for all configurations are presented in graphic and tabular form. A method of correcting for heat leakage in the borated polyethylene transducer is outlined, and the required empirical parameters, obtained from a bake-oven experiment, are given. Author

N64-15372 Emmanuel Coll., Boston, Mass. Research Language Center
SOUND ABSORPTION IN SOLID BODIES [Uber Schallabsorption in Festen Korpern]
L. Landau and G. Rumer Bedford, Mass., AFCRL [1963] 13 p Transl. into ENGLISH from Physik. Z. Sowjetunion (Kharkov), v. 11, 1937 p 18–25
(Contract AF 19(604)-8505)
(E-T-G-63-24; AD-428506)

The absorption of sound waves with short wavelengths is investigated. The process is described as the result of collisions between sound and heat quanta. A linear frequency dependence results from this for the absorption coefficients. Author

N64-15373 Emmanuel Coll., Boston, Mass. Research Language Center
USE OF THE FRESNEL ZONE PLATE FOR TESTING [Die Fresnel-Zonenplatte als Testobjekt]
A. Lohmann [1963] 12 p refs Transl. into ENGLISH from Optik (Stuttgart), 18(10–11), 1961 p 514–518
(Contract AF 19(604)-8505)
(E-T-G-63-32; AD-428503)

Methods for using the Fresnel-zone plate as a test instrument for measuring the contrast transfer function, point imaging, and magnification differences or distortions are discussed. Also, the use of the Fresnel-zone-plate theory for the distorted Moiré effect is discussed. This is applicable to the measurement of the transfer phase and the determination of magnification differences and distortion. I.v.L.

N64-15379 RAND Corp., Santa Monica, Calif.
A SIMPLIFIED MODEL OF THE LAMINAR WAKE OF A HYPERSONIC BODY FOR STUDYING ELECTROMAGNETIC EFFECTS
R. D. Engel May 1963 51 p refs
(ARPA Order 189-61; Contract ARPA-SD-79; Proj. RAND)
(RM-3649-ARPA; AD-406879)

A simplified analytical model is presented for investigating such wake characteristics as electron density, collision frequency, velocity, and temperature. The model furnishes the information that is necessary for studying the electromagnetic scattering properties of the wake. The model assumes inviscid laminar flow about a blunt body. A simplified expression for the enthalpy in the wake is derived from Lykoudis' universal solution. The enthalpy is then translated into the desired wake characteristics by using the equilibrium properties of air. For simplicity, the air is assumed to be in local equilibrium. This represents an approximation, since the air is strictly in local equilibrium only at lower altitudes where the wake is turbulent. A particular set of reentry conditions is considered as an example, and an analytical expression for the electron density is derived. The general structure of the wake is illustrated by plotting electron density contours. Author

N64-15380 RAND Corp., Santa Monica, Calif.
TWO CHARGED SPHERICAL CONDUCTORS IN A UNIFORM ELECTRIC FIELD: FORCES AND FIELD STRENGTH
M. H. Davis Jan. 1964 42 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-3860-PR; AD-428737)

A complete solution is presented to the electrostatic boundary value problem of two charged conducting spheres in a uniform electric field. Rapidly convergent expressions are given for the forces acting on the spheres, and for the maximum field strength between them. Numerical results are presented for a number of relative sphere sizes and separations. Author

N64-15387* Melpar, Inc., Falls Church, Va.
DETECTION OF EXTRATERRESTRIAL LIFE. METHOD II: OPTICAL ROTATORY DISPERSION Final Report
[1963] 47 p
(NASA Contract NASw-557)
(NASA CR-55657) OTS: $4.60 ph, $1.61 mf

The object of this study was to develop polarimetric methods to determine the presence of optically active materials, particularly DNA or its cogeners, in soil suspension. Provided that such methods can be developed, the determination of the existence of life (as known terrestrially) on other planets may be accomplished by remote instrumentation. Two new experimental approaches for measuring optical activity were developed; they are the electronic ratio of the difference to a constant and a modified form, i.e., the simple ratio. Based upon these new developments, an instrument was designed to detect extraterrestrial life by measuring the optical activity in soils. Also, it has been found that it is possible to concentrate the organic components in soil. Based upon the above findings, an extraction procedure has been developed that will enable extraterrestrial polarimetric measurements to be made of these organic compounds. I.v.L.

N64-15388* University of Southern Calif., Los Angeles
OPTICAL CONSTANTS OF METALS IN THE VACUUM ULTRAVIOLET REGION
W. Steinmann, E. I. Fisher, and G. L. Weissler 15 Jan. 1964 49 p refs
(NASA Grant NsG-178-61)
(NASA CR-55515) OTS: $4.60 ph, $1.67 mf

An ultra-high-vacuum system is described in which a clean metal surface can be prepared, and in which reflectivity at two angles and the optical constants of the reactive metals, which are difficult if not impossible to handle under ordinary high-vacuum conditions, can be measured. The system includes an ultra-high-vacuum chamber with sapphire windows, an oil-diffusion pump, a water-cooled baffle and a refrigerated (Freon 22) baffle, two bakable liquid-nitrogen traps, bakeout ovens, bakeout and liquid-nitrogen control circuitry, and interlock circuitry. The ultra-high-vacuum system will be used in conjunction with a normal-incidence-vacuum UV monochromator for measuring reflectivity. Also, a 1/2-meter normal-incidence-vacuum UV spectrograph is being used to investigate the transition-plasmon radiation phenomenon in aluminum. I.v.L.

N64-15390 Argonne National Lab., Ill.
INTERNATIONAL CONFERENCE ON NUCLEAR PHYSICS WITH REACTOR NEUTRONS, OCTOBER 15-17, 1963
F. E. Throw, ed. Nov. 1963 490 p refs Topical Conf. on the Am. Phys. Soc.
(Contract W-31-109-eng-38)
(ANL-6797)

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N64-15394 Atomic Energy Commission, Washington, D.C.
ISOTOPE DEVELOPMENT PROGRAM. CONTRACT SCOPE STATEMENTS
P. C. Aebersold (Div. of Isotopes Develop.) Sep. 1963 113 p (TID-4202) OTS: $2.25

The topics discussed include: (1) radioisotope and fission product production and separations technology; (2) isotopic power fuels development; (3) radiation-pasteurized foods; (4) process radiation development; and (5) radioisotope technology development. R.T.K.

N64-15396 Stanford U., Calif.
FIRST AND SECOND ORDER BEAM OPTICS OF A CURVED, INCLINED MAGNETIC FIELD BOUNDARY IN THE IMPULSE APPROXIMATION
R. H. Helm Nov. 1963 24 p refs
(Contract AT(04-3)-400)
(SLAC-24) OTS: $0.50

The second-order calculation of the magnetic boundary is extended to include off-midplane rays. In this case, the appearance of second derivatives in the field expansion introduces new terms that would not be found in a purely geometric calculation. The present calculation is essentially an impulse approximation and does not treat explicitly the finite extent of an actual fringing field. However, in the case of the first-order focusing, it is well known that the impulse approximation gives the dominant effect, and that semiempirical corrections to first order in the gap height give a very good representation of the first-order coefficients. Thus, it seems reasonable that the impulse calculation may give a useful first approximation for the second-order coefficients. I.v.L.

N64-15400 California U., Berkeley. Lawrence Radiation Lab.
K^-p ELASTIC SCATTERING AT 1.22 BeV/c
John H. Munson (Ph.D. Thesis, Pt. 11) 20 Dec. 1963 38 p refs
(Contract W-7405-eng-48)
(UCRL-11155) OTS: $1.00

Three thousand K^-p elastic scatterings at 1.22 Bev/c have been studied. These events are part of a sample of 7,000 events of the "two-prong" topology, produced in the Lawrence Radiation Laboratory 72-in. hydrogen bubble chamber, and measured on the new Scanning and Measuring Projectors of the Alvarez group. Fitting of the corrected elastic-scattering, center-of-mass angular distribution suggests that terms to $\cos^6\theta$ are needed, although a fit to $\cos^5\theta$ is not excluded. The elastic-scattering data, together with the published charge-exchange data from the same exposure and data at 1.34 Bev/c, are subjected to a partial-wave analysis, parameterized in terms of K^-p resonances at 1,765, 1,815, and 2,100 Mev. The predicted angular distributions are in good agreement with the experimental distributions. Dalitz plots are presented for the partially analyzed three-body reactions appearing in the two-prong topology and obtained as a by-product. Author

N64-15401 Atomics International, Canoga Park, Calif.
INPILE EXPERIMENTS ON RETENTION OF FISSION PRODUCTS IN 500°F SODIUM
W. P. Kunkel, D. M. Elliott, and A. S. Gibson 30 Jan. 1964 63 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-9163) OTS: $1.50

The results of three separate inpile capsule experiments are presented. The first experiment, IP-1, demonstrated the feasibility of using the KEWB transient reactor facility as a means of melting uranium in a sodium environment and thus injecting fission products into the sodium. In the second experiment, IP-0, terphenyl was substituted for sodium and permitted a comparison of the relative effectiveness of the two coolants in retaining fission products. With a prenuclear transient inventory of 5.2 mc of iodine-131, a 4-mil-thick, 93%-enriched uranium fuel disc, weighing 0.438 g and immersed in 235 g of 500° F sodium, was subjected to a 1-ms period nuclear transient, IP-2. The energy release in the fuel disc was approximately 0.66 Btu, which resulted from the 2.2×10^{13} fissions occurring in the disc during the burst. Approximately 1% to 10% of the preburst iodine inventory was released to the sodium, and less than 0.002% of the iodine in the sodium was released to the gas traps. Author

N64-15403 Rochester U., N.Y. Div. of Radiation Chemistry and Toxicology
AN INVESTIGATION OF THE INTERACTIONS THAT OCCUR BETWEEN RADIO-NUCLIDES AND AEROSOLS IN THE RESPIRABLE SIZE RANGE
Douglas Kenneth Craig 14 Feb. 1964 224 p refs
(Contract W-7401-eng-49)
(UR-636)

A labelled iron oxide aerosol was allowed to interact with radionuclides consisting of molecular sodium iodide with specific activities of from 0.15 to 15 mc I^{131}/mg NaI. The Goetz Aerosol Spectrometer was used to characterize the adsorption of NaI molecules onto the aerosol as a function of particle size. Relative radionuclide–aerosol concentrations were varied from 3×10^2 to 3×10^5 molecules per particle and mean interaction times by a factor of about 2.5. The following conclusions were drawn from these experiments: (1) Although considerable quantities of the radionuclide did become attached to the areosol, the adsorption process was not irreversible. (2) Variation of the experimental conditions over the above range did not significantly affect the results. (3) The adsorbed activity was proportional to a function $D(I)^Z$, where D (I) is the aerosol diameter and $2 \leq Z \leq 3$ over the approximate size range $0.06 < D(I) \leq 0.65\,\mu$ and possibly up to particle diameters as large as $1.2\,\mu$. Author

N64-15406* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SOME EFFECTS OF FLIGHT PATH AND ATMOSPHERIC VARIATIONS ON THE BOOM PROPAGATED FROM A SUPERSONIC AIRCRAFT
Raymond L. Barger Washington, NASA, Feb. 1964 31 p refs (NASA TR R-191) OTS: $0.75

Equations for the shock-wave envelope and cusp line associated with the boom propagated from a supersonic aircraft are formulated in terms of the moving-trihedral coordinate system for flight in a uniform atmosphere and also in an atmosphere with a linear sound-speed gradient. Ray-tube theory is used to calculate the lateral distribution of boom intensity in an atmosphere with a linear sound-speed gradient and also to investigate the effect of a general wind and sound-speed gradient on the ground-track intensity. The relative effects of wind and temperature gradient are treated. The mechanisms of focusing by winds and by ground structures are discussed qualitatively. Author

N64-15413 Joint Publications Research Service, Washington, D.C.
PHYSICAL AND MATHEMATICAL PRINCIPLES OF ELECTRICAL EXPLORATION WITH DIRECT CURRENT
In its Principles on Elec. Exploration 12 Feb. 1964 p 1–23 (See N64-15412 07-12) OTS: $2.00

A discussion is given concerning electrical exploration with direct current and the interpretation of field data, based on the principles of the theory of a direct electric current in a three-dimensional medium. An equation is given that expresses the law of conservation of electricity, which applies to that region of the medium in which there are no sources of electric charges. The Laplace equation and the boundary conditions that, in principle, make it possible to solve any problem concerning the distribution of current in any nonuniform, but isotropic, medium are also discussed. In geologic exploration by electrical means, the direct current is introduced into the earth through electrodes or groundings, and it is of great importance to know the value of the resistivity of such groundings. Formulas are given by which the resistivity of a system of several groundings can be computed. The ground field is discussed as is a study of fields of direct electric currents in nonhomogeneous isotropic media. C.L.W.

N64-15425 European Organization for Nuclear Research, Geneva (Switzerland) Accelerator Research Div.
CHROMATIC ABERRATIONS IN QUADRUPOLE MULTIPLETS
E. Regenstreif (Faculté des Sci.) 13 Dec. 1963 108 p refs
(CERN 64-2)

Chromatic aberrations play an important role in the design and in the properties of beam transport channels. They may, for instance, impair the performance of particle separators by broadening the images at the separation slits, and thus reduce the physical separation of the wanted and unwanted particles. Minimum aberrations and optimum performances are also required in long flight-path systems. In this report, explicit formulas are derived for the chromatic aberrations of a composite-lens system. Applications of the formulas are made to quadrupole doublets and triplets, with particular reference to symmetric systems and stigmatic operation. It is shown that it is possible to choose operating conditions leading to minimum aberrations. I.v.L.

N64-15452 Advisory Group for Aeronautical Research and Development, Paris (France)
LIGHT AND HEAT SENSING. SIXTH AGARD AVIONICS PANEL MEETING, PARIS, JULY 1962
Harrison J. Merrill, ed. Oxford, N.Y., Pergamon, 1963 468 p refs
(AGARDograph-71)

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27. HIGH-SENSITIVITY, LONG-RANGE DETECTOR IN THE INFRARED SPECTRUM H. J. L. Le Boiteux (ONERA) p 437–450 refs (See N64-14579 07-23)

N64-15453 Polaroid Corp., Cambridge, Mass.
INFORMATION CAPACITY OF SENSORS OF HEAT AND LIGHT
R. Clark Jones *In* AGARD, Paris Light and Heat Sensing 1963 p 3–12 refs (See N64-15452 07-23)

This paper is a summary of four papers that have appeared in the Journal of the Optical Society of America. Author

N64-15454 Royal Radar Establishment, Malvern (Gt. Brit.)
RECENT ADVANCES IN INFRARED DETECTORS
V. Roberts *In* AGARD, Paris Light and Heat Sensing 1963 p 13–24 refs (See N64-15452 07-23)

This paper briefly reviews the present state-of-the-art on thermal detectors and photodetectors, and treats in more detail the development of InSb photoconductive dectectors for both the near and far infrared. As a result of these developments, it is now possible to make fast sensitive photodetectors for all infrared wavelengths from the visible limit to overlap the microwave region at a few millimeters. Progress is reported on a new scheme for a tunable infrared detector based on cyclotron absorption by free carriers in semiconductors. Author

N64-15455 Optical Industries N. V., Delft (Netherlands)
LIMITS OF IMAGING AT LOW BRIGHTNESS
H. G. De Winter *In* AGARD, Paris Light and Heat Sensing 1963 p 25–29 refs (See N64-15452 07-23)

As is now generally recognized, the photon noise may become noticeable at very low brightness levels. With sensitive receivers this noise will be the ultimate limit for the resolution. Apart from this, receivers such as image intensifier systems show a transfer of contrast, which diminishes for smaller object sizes. The limit of perceptibility of objects at low brightness levels is determined from the transfer characteristics of the system. Author

N64-15456 Radio Corp. of America, Princeton, N. J. Astro Electronics Div.
ULTRAVIOLET IMAGING FROM SATELLITES
Edwin C. Hutter *In* AGARD, Paris Light and Heat Sensing 1963 p 31–42 refs (See N64-15452 07-23)

Two representative specific systems have been studied and are described. One, for stellar observation, is designed to possess a high sensitivity in the region of the Lyman-alpha line of 1216 A. It employs an image orthicon with a special photoemitter and a lithium fluoride window. The other system is designed for solar observation in the region of 10 to 800 A. It employs zone plate optical elements and a phosphor for conversion to light in the visible spectrum. Theoretical calculations on the performance of these overall systems and results of experimental work on critical camera-tube elements are described. Tests on zone plates have shown that sufficient resolution to match the capabilities of conventional camera tubes can be obtained from physically realizable structures. Author

N64-15457 Compagnie Générale de Télégraphie sans Fil, Orsay (France)
COMPARATIVE ADVANTAGE OF INFRARED AND HERTZION RADIOMETRICS [INTERET COMPARE DES RADIOMETRIES INFRAROUGE ET HERTZIENNES]
G. Broussaud and B. Richard *In* AGARD, Paris Light and Heat Sensing 1963 p 43–73 refs In FRENCH (See N64-15452 07-23)

The detection of remote objects by radar technique has made possible the prodigious development of electronics. It must, however, be admitted that this detection system has a serious disadvantage regarding the apport of the important energy. The radiometer, which uses the natural thermodynamic radiation of material objects, has, in this respect, a certain advantage. Whether this method, which is still in its preliminary

stage, is further developed depends upon the working out of techniques that are within the limits of actual possibility. It is a question of the amplification of the weak noise of very-high-frequency waves that exist in the region between the infrared and the centimeter waves. Trans. by I.v.L.

N64-15458 German-French Research Inst., Saint-Louis (France)

CONCENTRATIONS OF DUSTS IN THE HIGH ATMOSPHERE [CONCENTRATIONS DE POUSSIERES DANS LA HAUTE ATMOSPHERE]

Fritz Rössler *In* AGARD, Paris Light and Heat Sensing 1963 p 77–85 refs In FRENCH (See N64-15452 07-23)

During the launching of the Véronique rocket during the spring of 1961 at Hamaguir, the variation of the diffused light of the sky was measured as a function of altitude. The light decreased in a continuous manner as far as the measured area extended. Contrary to other published measurements, no layer exists in which luminescent emission will be constant. The measurement allows the deduction of the emission in the different layers. This magnitude, expressed in cd/kg, decreases initially up to the troposphere and is followed by an increase to the maximum value at 25 km. The variation is caused by the presence of dust in the atmosphere and indicates the concentration of the dust particles. At certain moments, the solar light penetrated directly into the photomultiplier and permitted the determination of the speed of rotation and of the precession of the rocket. Trans. by I.v.L.

N64-15459 Army Signal Research and Development Lab., Fort Monmouth, N.J.

ATMOSPHERIC AEROSOL PARTICLE SIZE DISTRIBUTIONS AND THEIR INFLUENCE ON THE LIGHT SCATTERING PROPERTIES OF THE ATMOSPHERE

Robert W. Fenn *In* AGARD, Paris Light and Heat Sensing 1963 p 87–88 refs (See N64-15452 07-23)

The light-scattering properties of single, natural aerosol particles are analyzed. Based on the scattering theory of Mie (1908), the extinction coefficients and scattering functions for spherical particles with refractive index 1.55 and size parameter values $\alpha = \pi\ r/\lambda$ between 0.1 and 15 have been computed. The influence of various power-series aerosol size distributions and particle-size ranges on the scattering function is discussed. Based on the above analyses, the optical properties of the atmosphere are investigated by measurements of the aerosol-particle concentrations and size distributions and by measurements of the sky brightness. Such measurements have been conducted in the Smoky Mountain area of Tennessee, in the Gila Desert of Arizona, and in the Texas prairie area. The light scattered back into space by the air molecules and by the aerosol particles has been computed for the Texas measurements assuming ground albedo values of 0.0, 0.25, and 0.8, and for various sun elevations. I.v.L.

N64-15460 Royal Aircraft Establishment, Farnborough (Gt. Brit.)

THE USE OF STARS IN ESTIMATING THE ATTENUATION OF LIGHT IN THE ATMOSPHERE

A. N. Mosses *In* AGARD, Paris Light and Heat Sensing 1963 p 89–99 refs (See N64-15452 07-23)

The method of using stars was developed to estimate attenuation during night photographic trials. When first (or last) seen rising above (or falling towards) the horizon, a star has a residual brightness that can be estimated numerically. A knowledge of its absolute brightness and measurement of its angle of elevation at appearance (or disappearance) enable the light loss to be related to the length of the light path in the atmosphere. If it is assumed that most of the attenuation occurs below the height of the light source, the attenuation of the light passing at any known angle can be estimated. No assumptions about the thickness or composition of the haze layer are necessary. Author

N64-15461 National Defence Research Organization T.N.O., The Hague (Netherlands)

EVALUATION OF THE IMAGE INTENSIFIER

H. J. Dirksen and J. Van Schie *In* AGARD, Paris Light and Heat Sensing 1963 p 103–114 refs (See N64-15452 07-23)

A general method is introduced to describe what is just visible with the naked eye and with the eye assisted by different night vision equipment. What can be seen with image intensifiers with objectives of different sizes and one or more stages is emphasized. Finally, the diameter of the objective of an image intensifier with which "everything" can be seen at a given brightness level is calculated. Author

N64-15462 Royal Aircraft Establishment, Farnborough (Gt. Brit.)

AIR-TO-GROUND APPLICATIONS OF VISUAL DETECTION LOBE THEORY

E. Heap *In* AGARD, Paris Light and Heat Sensing 1963 p 115–136 refs (See N64-15452 07-23)

This paper considers air-to-ground applications of the theoretical equations for visual detection lobes that depend upon the observed contrast of an object and its area. Taking into account the meteorological range, atmospheric attenuation, and the sky-to-ground brightness ratio, curves are produced that show the sectional area on the gound within which detection is possible. Optimum heights and look angles are determined such that the ground area is maximized for a given maximum slant range to the ground. Details of many varied detection lobes are also tabulated. The results show that the performance of the naked eye is extremely limited in some circumstances and that there is a need for improvement by the development of new devices for aided vision. Author

N64-15463 France. Office National d'Etudes et de Recherches Aeronautiques, Chatillon-sous-Bagneux (France)

THE DESCREENING OF IMAGES AS A MEANS OF OPTIMAL UTILIZATION OF INFORMATION [LE DETRAMAGE DES IMAGES COMME PROCEDE D'UTILISATION OPTIMALE DES INFORMATIONS]

J. Surget and C. Veret *In* AGARD, Paris Light and Heat Sensing 1963 p 137–149 refs In FRENCH (See N64-15452 07-23)

A plane optical object can perhaps be represented as a function of the position of each of its points in the plane, developed in series or in Fourier integrals. The frequency of the sinusoidal components of the Fourier is a spatial frequency. An optical system allowing the reproduction of this object can perhaps be considered as a filter of spatial frequencies of the object. There exists in this system a particular plane in which the distribution of the luminescent vibrations corresponds to the frequency spectrum of object function. By placing suitable masks in this plane, it is possible to act selectively on the spatial frequencies with certain ones being favored because of their rapport to the others. For example, if the object is regularly half-tone, one can strongly attenuate the frequency corresponding to this half-tone. Examples of the application of this technique are the descreening of printed photographs, the suppression of lines in TV images, and the descreening of striograms taken at the cross section of perforated walls set up at the nozzle of a transonic wind tunnel. Trans. by I.v.L.

N64-15464 Bristol Aircraft Ltd. (Gt. Brit.) G. W. Engineering Dept.

THE STUDY OF TIME AND SPACE VARIABLE SURFACE TEMPERATURES OF SELF-LUMINOUS BODIES AND OTHER BRIGHTNESS PARAMETERS BY COLOUR DENSITOMETRY

I. Overington *In* AGARD, Paris Light and Heat Sensing 1963 p 151–181 refs (See N64-15452 07-23)

Certain surface temperature measurements met with in hypersonic-flow investigations, where high rates of change of temperature with time and space are coupled with ablation problems, make conventional temperature measurement techniques unsatisfactory. To combat this, a system of photographic densitometry making use of the stability and predictability of modern color film, together with a novel sampling camera, has been developed. This system is easy to handle, can accept brightness levels of over 10^6:1 at one setting, and can sample temperatures of up to 300 points at rates from 4 to 25 samples per second in its present form. The system also provides valuable pictorial data on features such as ablation rate and shock patterns, and the use of color film enables temperatures to be estimated when gray bodies of unknown emissivity are under observation. Absolute accuracies of better than 10° C at 1,500° C are claimed with known emissivity, and relative temperatures may be measured to better than 3.5° C at 1,500° C. Author

N64-15468 Royal Aircraft Establishment, Farnborough (Gt. Brit.)

METHODS OF MODULATING INFRARED RADIATION

T. S. Moss *In* AGARD, Paris Light and Heat Sensing 1963 p 207–220 refs (See N64-15452 07-23)

Various methods of modulating infrared radiation are discussed, with emphasis on systems that can operate at very high frequencies, the aim being to modulate up to $\sim 10^{10}$ c/s (10-cm to 1-cm wavelength). Three classes of effect are considered, which are based on three types of limiting time constant: (1) effects limited by carrier lifetimes in semiconductors (i.e., time before recombination of electron-hole pairs); (2) solid-state devices limited by scattering times; and (3) pure field effects. Devices using pure field effects have negligible delay times and are potentially capable of operating at the highest frequencies desired. Frequency response and degree of modulation are estimated in terms of fundamental limitations and of practical materials. Author

N64-15471 American Optical Co., Southbridge, Mass.

FIBER OPTICS—PRINCIPLES, PROPERTIES AND DESIGN CONSIDERATIONS

Walter P. Siegmund *In* AGARD, Paris Light and Heat Sensing 1963 p 265–296 refs (See N64-15452 07-23)

The basic principles of fiber optics are reviewed, and the properties of a variety of fiber-optics materials are described. Important design considerations are discussed with respect to the application of these materials to various optical problems. To illustrate these design considerations, a number of specific optical problems and their possible solution by means of fiber optics are described. Author

N64-15472 Radio Corp. of America, Camden, N.J. Defense Electronic Products

FIBER OPTICS AND ITS USE IN ELECTRO-OPTICAL DEVICES

L. J. Krolak *In* AGARD, Paris Light and Heat Sensing 1963 p 297–310 (See N64-15452 07-23)

A number of fiber-optics configurations have been developed. These exploit three unique features to improve the performance and decrease the complexity of image-handling systems: The flexible bundle, the shape transducer, and the solid vacuum-tight faceplate. The advantages of these features in electrooptical systems are described briefly. Four of the devices to which fiber optics have been applied are discussed in some detail. One is an airborne camera, utilizing a fiberscope and a special vidicon picture tube with a fiber-optics faceplate. The second is a unique type of high-speed printer in which the fiber-optics bundle is combined with a special fiber-optics cathode-ray tube. The third is a high-resolution television reconnaissance system in which fiber optics makes it possible to increase the effective resolution and to take advantage of the unsurpassed sensitivity of the image orthicon for high-quality reconnaissance as well as high-speed facsimile. The fourth is an improved analog-to-digital converter. Author

N64-15473 Optics Technology, Inc., Belmont, Calif.

OPTICAL SYSTEMS USING FIBER OPTICS

David F. Capellaro *In* AGARD, Paris Light and Heat Sensing 1963 p 311–324 (See N64-15452 07-23)

Many practical uses have been proposed for fiber optics, both in combination with conventional optical systems and alone in instruments utilizing their unique characteristics. These systems offer many advantages, such as high photometric efficiency, image dissection possibilities, greater design freedom in the conventional optical components, and the ability to view remote or inaccessible areas. Through a new technique, it has also become possible to view and to image opaque objects through fibers alone. The design of such systems and their performances are discussed. Several specific systems, as well as different configurations using fiber optics for viewing opaque objects, are described, both as examples of optimized design and in order to demonstrate the practical application of fiber optics. Author

N64-15474 France. Office National d'Etudes et de Recherches Aeronautiques, Chatillon-sous-Bagneux

UTILIZATION OF OPTICAL TRIKEDRALS FOR THE LOCALIZATION OF A MOVING BODY IN SPACE [UTILISATION DES TRIEDRES OPTIQUES POUR LA LOCALISATION D'UN MOBILE DANS L'ESPACE]

R. Moreau *In* AGARD, Paris Light and Heat Sensing 1963 p 327–336 In FRENCH (See N64-15452 07-23)

Tetrahedrons of transparent materials have the property of reflecting an incident pencil of rays following one direction that is adjacent to that direction chosen as the direction of entrance. This property has a number of advantages and, in particular, permits the envisioning of the devices of an optical trajectograph for the determination of portions of a missile trajectory, which do not require the presence of a light source onboard the engine. Preliminary experiences aim, in particular, at defining the capacity that may be ascribed to such devices. Also discussed are the possibilities of extending this technique to problems of spatial research. Transl. by I.v.L.

N64-15475 Northrop Corp., Hawthorne, Calif. Northrop Space Labs.

DETECTION OF SATELLITES AND SPACE PROBES BY MEANS OF ULTRAVIOLET VISIBLE AND INFRARED RADIATIONS

K. N. Satyendra *In* AGARD, Paris Light and Heat Sensing 1963 p 337–370 refs (See N64-15452 07-23)

The detection problem is discussed in terms of: (1) signal attenuation if the observer is on ground; (2) eclipsing of the space vehicle by the earth, i.e., the magnitude and duration of target signal when the vehicle is outside and when the vehicle

is inside the earth's shadow; (3) target signal variation due to phase angle for diffuse reflection; and (4) size, shape, and reflecting properties of target vehicle and its distance from observer. Typical detection ranges are calculated in the ultraviolet (below 0.4μ), visible (between 0.4μ and 0.7μ), and infrared (above 0.7μ) parts of the spectrum. The techniques for calculating the orbits of target space vehicles by such optical observations are presented, and typical accuracy figures are mentioned for illustration. The problems of detection of target space vehicles on board a manned vehicle are discussed with some quantitative estimates of the signal-processing problem and the need for large data-processing capability.

Author

N64-15479 France. Office National d'Etudes et de Recherches Aeronautiques, Chatillon-sous-Bagneux

HIGH-SENSITIVITY, LONG-RANGE DETECTOR IN THE INFRARED SPECTRUM [DETECTEUR A SENSIBILITE ELEVEE ET DE GRANDE ETENDUE DANS LE SPECTRE INFRAROUGE]

H. J. L. Le Boiteux *In* AGARD, Paris Light and Heat Sensing 1963 p 437–450 refs In FRENCH (See N64-15452 07-23)

The use of infrared radiation emitted by the atmosphere and by space and the contrast between the two sources permit the determination, at the takeoff of an aerospace vehicle, of a "horizon" and consequently give a direction of reference. The detectors of radiation, in this application, fulfill a certain number of conditions often difficult to reconcile, particularly those in relation to sensitivity, the area in the spectrum, and the response curve. A precise method for determining the static and dynamic characteristics of the detector is necessary. Such a method has been pursued by O.N.E.R.A., to a certain degree, in the modification of a pneumatic detector. A new detector of the thermal type, associated with measurement by capacity variation, has been realized and adapted as have circuits.

Trans by I.v.L.

N64-15494 Northeastern U., Boston, Mass.

ELECTRICAL AND OPTICAL PROPERTIES OF SOME METAL CHELATES

A. K. Ghosh and S. Chatterjee (AFCRL) *In its* Res. in Energy Conversion 22 Nov. 1963 p 285–297 refs (See N64-15489 07-01)

The conduction properties of heterocyclic transition-metal complexes and unusual properties of compounds derived from phthalocyanine are discussed. Results and discussion of studies with phthalocyanines and the preparation and properties of transition-metal complexes of 6-mercaptopurine and 4-mercapto-6,7-diphenylpteridine are presented.

R.T.K.

N64-15501 European Organization for Nuclear Research, Geneva (Switzerland)

THE 1963 NPA SEMINARS. THE NEUTRINO EXPERIMENT

Carlo Franzinetti, ed. Dec. 1963 237 p refs (CERN-63-37)

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N64-15502 European Organization for Nuclear Research, Geneva (Switzerland)

THEORETICAL INTRODUCTION

J. S. Bell 5 Feb. 1963 *In its* The 1963 NPA Seminars. The Neutrino Expt. Dec. 1963 p 1–20 refs (See N64-15501 07-23)

This theoretical introduction to the neutrino experiment includes discussions of the following: (1) the intermediate vector boson; (2) the number and kinds of neutrinos involved in the intermediate boson scheme; (3) muon and electron conversion; (4) μ-e universality; (5) neutral currents, i.e., neutral intermediate bosons; (6) the electron as the target; (7) vector particle edchange; (8) form factors in $+\nu + n \rightarrow l + p$ and $\bar{\nu} + p \rightarrow \bar{l} + n$; and (9) inelastic reactions.

I.v.L.

N64-15503 European Organization for Nuclear Research, Geneva (Switzerland)

PRODUCTION AND DECAY OF THE VECTOR BOSON

M. Veltman 21 Feb. 1963 *In its* The 1963 NPA Seminars. The Neutrino Expt. Dec. 1963 p 21–32 refs (See N64-15501 07-23)

Diagrams are presented showing the process through which the vector boson, if it exists, can reveal itself. On the basis of these diagrams, the following final states for the decay of the vector boson, W^+, are possible: (1) leptonic decay: $W^+ \rightarrow e^+ = \mu$, $W^+ \rightarrow \mu^+ + \mu$; (2) mesonic decay: $W^+ \rightarrow \pi^+ + \pi^0$, $W^+ \rightarrow K + \pi$, $W^+ \rightarrow K + K$; and (3) photonic decay: $W^+ \rightarrow N^+ + \mu$, $W^+ \rightarrow K^+ + \mu$. Reasonable estimates of their relative frequency indicate that only the first four are likely to be produced in appreciable amounts. In addition, decays into more than two particles are possible. Also discussed are the estimated dependence of the decay rates of the vector boson upon its mass; the coherent production of the vector boson wherein the collision is presumably peripheral in nature and the nucleus enters into the process as a compact object; the incoherent

production of the vector boson wherein the scattering probably occurs on a single proton that recoils, interacting in the nucleus or breaking away from it; and the dependence of vector boson coherent and incoherent production on the nature of the target. I.v.L.

N64-15504 European Organization for Nuclear Research, Geneva (Switzerland)
THE BROOKHAVEN NEUTRINO EXPERIMENT
J. M. Gaillard 28 Feb. 1963 *In its* The 1963 NPA Seminars. The Neutrino Expt. Dec. 1963 13 p refs (See N64-15501 07-23)

The source of neutrinos was pions and kaons produced by 15-Gev protons hitting a beryllium target at the beginning of a three-meter straight section of the AGS. One hundred and thirteen events corresponding to 3.48×10^{17} accelerated protons were obtained inside a fiducial region of the chamber. These events were classified into four categories: 49 short tracks (visible momentum if μ's < 300 Mev/c), 34 long tracks (visible momentum if μ's > 300 Mev/c), 22 vertices, and 8 showers. The neutrino origin of the events is discussed. The events are interpreted from the standpoints of: assumed and nonassumed universality, the neutrino flip hypothesis, and the number of elastic and inelastic events. It was noted that five or six of the observed events could be due to intermediate boson production. I.v.L.

N64-15505 European Organization for Nuclear Research, Geneva (Switzerland)
THE SPARK CHAMBER NEUTRINO EXPERIMENT AT CERN
H. Faissner 7 Mar. 1963 *In its* The 1963 NPA Seminars. The Neutrino Expt. Dec. 1963 38 p refs (See N64-15501 07-23)

Two modular spark chambers are described that are based upon the track-analysis requirement that the plates must be thick and that the counter spacing can be correspondingly large. Two three-plate modules were built, one having 5-mm Al plates and the other having 5-mm brass plates. Also, the geometry and the operation of the neutrino setup are described. The expected rates from this set-up are: Eighty-five elastic events/day are expected of the production region; but only ≈ 90%, i.e., 68/day or 2.8/hour will fall inside the fiducial volume and only ≈ 1/3 of them will stop. The range chamber is expected to contribute the same amount of elastic triggers. A neutrino trigger rate of about 15/hour is expected for the inelastic events. It is hoped that six analyzable bosons of 600 Mev will be produced per day. The problems that the spark-chamber neutrino experiment expects to investigate are: (1) the production of a boson as a real particle in a third-order process; (2) the one-or-two-neutrino question; (3) form factors due to strong interactions; (4) lepton conversion; (5) inelastic reactions; and (6) elastic neutretto–proton scattering. I.v.L.

N64-15506 European Organization for Nuclear Research, Geneva (Switzerland)
THE USE OF THE BUBBLE CHAMBER IN THE NEUTRINO EXPERIMENT
D. C. Cundy 14 Mar. 1963 *In its* The 1963 NPA Seminars. The Neutrino Expt. Dec. 1963 12 p (See N64-15501 07-23)

The bubble chamber in the neutrino experiment is described. Before starting the experiment proper, background sources such as cosmic rays and neutron background will be investigated. Three elastic events/day, and for the intermediate boson, $m_w = 6$ mp ~ 3 events/day and $m_w = \frac{1}{2}$mp ~ 1/4 event/day are expected. It is planned, during the run, to develop and scan the film continuously. The Thresh Geometry Program and the Grind Kinematics Program will be used in the measuring process. Two methods are available for distinguishing between π and μ. The first method uses the particle characteristics, such as 50% of μ^- stopping gives electrons, 30% of π^- stopping gives no visible products, and the interaction cross section for pions of a certain energy is known. The second method uses the fact that if the momentum and range of a particle are known sufficiently well, then π and μ can be distinguished up to a momentum of about 600 Mev/c. Elastic events are expected to fall into two categories—clean events, in which only a proton and a μ^- are produced, and dirty events, in which the proton has broken up the nucleus on its way out. The inelastic events will be those in which pions and, perhaps, strange particles are produced. It appears that the boson mass will be determined indirectly, i.e., by the method of transverse momentum. I.v.L.

N64-15507 European Organization for Nuclear Research, Geneva (Switzerland)
FAST BEAM EXTRACTION AND THE EXTERNAL PROTON BEAM
B. Kuiper and G. Plass 21 Mar. 1963 *In its* The 1963 NPA Seminars. The Neutrino Expt. Dec. 1963 24 p refs (See N64-15501 07-23)

A system is described for the extraction of the CPS proton beam and its transport to the target in the neck of the magnet horn. The proton beam will be displaced from its normal position into the aperture of a "septum" magnet by the excitation of betatron oscillations by means of a fast pulsed magnet. The "septum" magnet, which is a bending magnet, will eject the beam from the synchrotron. The ejected proton beam will be guided to the target by deflection magnets and quadrupole lenses. TV cameras will be used for beam observation. Fluorescent screens and beam-current-measuring transformers will monitor the ejected beam. I.v.L.

N64-15508 European Organization for Nuclear Research, Geneva (Switzerland)
NEUTRINO FLUX CALCULATIONS
S. van der Meer and K. M. Vahlbruch 28 Mar. 1963 *In its* The 1963 NPA Seminars. The Neutrino Expt. Dec. 1963 33 p refs (See N64-15501 07-23)

A description is given of the method used for calculating the neutrino flux at the detectors, taking into account the focusing provided by the neutrino horn. Results of the computations for various experimental conditions are presented.
Author

N64-15509 European Organization for Nuclear Research, Geneva (Switzerland)
NEUTRINO SPECTRA FROM THE TWO-BODY DECAY OF RELATIVISTIC PARENTS
C. A. Ramm 4 Apr. 1963 *In its* The 1963 NPA Seminars. The Neutrino Expt. Dec. 1963 31 p refs (See N64-15501 07-23)

The production of neutrino fluxes at a distance d from a limited isotropic source of monoenergetic relativistic parents of a particular γ, and decay length λ, is considered in terms of the angular divergence ϕ and the flight path r. If $\gamma\phi >> 1$ and $\lambda > > r$, the axial neutrino flux per unit area is $n_1 = r/\lambda d$ per parent per unit solid angle, and the differential energy spectrum extends from 2 $\gamma E'_\nu$ to zero, so that the mean energy is $\gamma E'_\nu$. If d-r is fixed by shielding requirements, the maximum flux density is for an arramgement where r = d/2. If $\gamma\phi >> 1$, the maximum achievable axial neutrino flux tends to limit $\gamma^2/\pi\lambda$ $(d-r)^2$ with the mean energy 2 $\gamma\epsilon'_\nu$. The relation between neutrino fluxes from pencil beams and slightly divergent beams

of parents is discussed, and the matching between the arrangement of the neutrino detectors and the degree of parent focusing is examined. Also, relationships developed in this report are used to examine the neutrino fluxes that are achievable, in principle, by pencil focusing of the know parent spectra from the PS. I.v.L.

N64-15510 European Organization for Nuclear Research, Geneva (Switzerland)
THE MAGNETIC SPARK CHAMBER
Guy von Dardel 18 Apr. 1963 *In its* The 1963 NPA Seminars. The Neutrino Expt. Dec. 1963 17 p refs (See N64-15501 07-23)

The proposed magnetic spark chamber setup consists of a solid iron-base plate acting as a return path for the flux. Twenty 5-cm iron plates, in the form of an inverted U, stand on the base plate and can be clamped to two rails with spacings that are sufficient to accommodate spark chambers and counters. It is hoped to make spark chambers with a plexiglass frame, completely transparent, that is fixed to a 5-mm aluminum central electrode plate. The two outer electrodes would be 0.1-mm foils under strong tension. Triggering counters in the magnetic spark chamber will make the first half of the chamber useful as a 10-ton production region of relatively low resolution, whereas the last part functions only as a range chamber with sign determination. The characteristics of a magnetic spark chamber of 2-m total length with 4-cm gaps for the standard two-gap aluminum spark chamber are given. The incorporation of a magnetic field in the neutrino detector that measures the sign of the lepton is useful as a check of lepton conservation and as a signature for vector boson production. I.v.L.

N64-15511 European Organization for Nuclear Research, Geneva (Switzerland)
ON THE SPARK FORMATION IN THE SPARK CHAMBER
S. Fukui 25 Apr. 1963 *In its* The 1963 NPA Seminars. The Neutrino Expt. Dec. 1963 19 p refs (See N64-15501 07-23)

Spark formation in a spark chamber is described, assuming that the streamer theory is applicable in the pulsed field across a relatively high-pressure gas. The behavior of electrons is discussed from the moment of their creation to their disappearance through the stage of spark formation. The streamer theory introduced by Meek and Raether is outlined briefly. Author

N64-15512 European Organization for Nuclear Research, Geneva (Switzerland)
EXPECTED FREQUENCIES OF EVENTS AND EVALUATION OF DATA IN THE SPARK CHAMBER EXPERIMENTS
R. Salmeron 11 Apr. 1963 *In its* The 1963 NPA Seminars. The Neutrino Expt. Dec. 1963 21 p refs (See N64-15501 07-23)

The following data are presented: (1) the number of grams/cm^2 and the energy loss of a minimum ionizing particle for each of the 16 carriages in the production region; (2) the number of grams/cm^2 and the energy loss of a minimum ionizing particle in the range region; (3) the intensity of the neutrino flux in the 5 concentric zones at the center of the production region of the spark chambers for protons of 24.8 Gev/c; (4) total cross sections σ_i for the incoherent process $\nu + p \rightarrow p + W^+ + \mu^-$; (5) total cross sections for the process $\nu + Al \rightarrow Al + W^+ + \mu^-$; (6) total cross sections for the process $\nu + Cu \rightarrow Cu + W^+ + \mu^-$; (7) the number of events of $\nu + {}^{\pi}_{p} \rightarrow {}^{\pi}_{p} + W^+ + \mu^-$/(ton of Al or Cu X day X 10^{11} circulating protons) at the spark chamber, assuming $\eta_m = \eta_d = 1$, where η_m is the machine efficiency and η_d is the detector efficiency; the number of these reactions was compared to that number of the same reaction in a bubble chamber. In the case of the reaction $\nu + {}^{\pi}_{p} \rightarrow {}^{\pi}_{p} + W^+ + \mu^-$, with the subsequent decay of $W^+ \rightarrow \mu^+ + \nu$, the differential cross sections of the particles W^+, μ^+, μ^- were computed and chamber. In the case of the reaction $\nu + {}^{\pi}_{p} \rightarrow {}^{\pi}_{p} + W^+ + \mu^-$, with the subsequent decay of $W^+ \rightarrow \mu^+ + \nu$, the differential cross sections of the particles W^+, μ^+, μ^- were computed and integrated over the neutrino spectrum. I.v.L.

N64-15513 European Organization for Nuclear Research, Geneva (Switzerland)
ELEMENTARY THEORY OF HIGH ENERGY NEUTRINO INTERACTIONS
M. Veltman 2 May 1963 *In its* The 1963 NPA Seminars. The Neutrino Expt. Dec. 1963 p 179–201 ref (See N64-15501 07-23)

Formulas that form the basis of calculations concerning high-energy neutrino interactions are presented and developed. The main concern is with cross sections and lifetimes that will be calculated from Lagrangians or Hamiltonians. The fields of the particles are the scalar, spinor, and vector fields and normalized solutions are obtained for a definitie particle momentum in the case of each field. The lifetime of an uncharged vector boson decaying into a neutrino and an antineutrino is calculated, and the production of a vector boson by a neutrino in the Coulomb field of a nucleus, with a charge Z, is investigated. I.v.L.

N64-15514 European Organization of Nuclear Research, Geneva (Switzerland)
ELASTIC NEUTRINO INTERACTIONS
J. Løvseth 4 Jun. 1963 *In its* The 1963 NPA Seminars. The Neutrino Expt. Dec. 1963 16 p refs (See N64-15501 07-23)

This report considers the process $\nu + n \rightarrow p + \ell$ when the neutron is contained in a nucleus. The ideal Fermi gas, corresponding to an infinitely deep, potential well, is used as the nuclear model. In the initial state, all levels will be filled up to Fermi momentum P_F. For $r_0 = 1.12$ Fermi one has $P_F = 267$ Mev/c. For a scattering event to take place, the exclusion principle requires that the 3 momentum of the final nucleon is outside the Fermi sphere, i.e., $P' > P_F$. The Fermi model has the advantage in that nucleon wave functions are plane waves; therefore, the cross section can be calculated as in the free nucleon case and, afterward, it can be averaged over the initial 3-momentum distribution with the restriction $P' > P_F$. I.v.L.

N64-15515 European Organization for Nuclear Research, Geneva (Switzerland)
PRELIMINARY DATA FROM THE NEUTRINO PRE-RUN (13-16 JUNE 1963)
In its The NPA Seminars. The Neutrino Expt. Dec. 1963 17 p (See N64-15501 07-23)

The machine intensity was about 7 X 10^{11} protons per second during most of the run. The operating voltage of the kicker magnet was chosen to give an ejection efficiency of 18 bunches of the possible 20. The magnetic horn was operated at maximum current to focus the positive particles. Results of the measurement to estimate the neutrino spectrum are not yet known. Diagrams are presented of the bunch structure of the ejected beam current just in front of the target in the magnetic horn and of the geometrical dimensions of the ejected beam focused at the target in the horn. Diagrams are also presented of: (1) events found in the heavy-liquid bubble chamber during fast scanning; and (2) events found in the spark chamber.

the case of (2), four selected events are shown. In all cases, the long track is compatible with a muon. The short track could be a recoil proton. All four of these events are consistent with elastic neutrino events. I.v.L.

N64-15520 Naval Ordnance Lab., White Oak, Md.
ELASTIC WAVE DECAY II
Paul Harris Feb. 1964 27 p refs
(NOLTR-63-219; AD-428843)

A time-dependent nonlinear formulation of shock propagation in an originally isotropic medium is presented. It is postulated that such a formulation accounts for the known nonlinearity of the dissipative mechanisms that result in the decay of elastic waves in crystalline solids. By combining this nonlinear theory with the appropriate conservation equations, characteristics and characteristic equations are derived that explicitly contain dispersion and decay in terms of unknown functions of the solid medium in question. By applying theory and experimental data available from ultrasonics, the functions of importance to the linear region are found. The growth and decay of the amplitudes associated with the first nonlinear contributions are traced by seeking solutions of a nonlinear wave equation and applying appropriate boundary conditions. Author

N64-15525 Defense Documentation Center, Alexandria, Va.
EXPLODING WIRES, FILMS, AND RIBBONS Annotated Bibliography
3 Jun. 1963 14 p refs
(AID-B-63-78; AD-406244) OTS: $1.60 ph, $0.80 mf

Included in this bibliography are 14 Soviet periodicals covering the period from 1956 to June 1963. E.W.

N64-15541* Martin Co., Baltimore RIAS Div.
RELATIONSHIP BETWEEN LIGHT INDUCED EPR SIGNAL AND PIGMENT P700
Heimut Beinert and Bessel Kok Repr. from Photosyn. Mech. in Green Plants, NAS-NRC Publ. 1145 1963 p 131–137 refs
(NASA Contract NASw-747)
(NASA CR-55356) OTS: $1.10 ph, $0.80 mf

An investigation to determine the relationship of (1) the number of spins represented by the light-induced EPR signal and (2) the amount of chlorophyll and P700 present in a variety of materials (red alga strain TX 27, anacystis, chloroplasts, and R. rubrum) is discussed. It is concluded that the number of unpaired electrons induced by light in the photosynthetic materials studied are either approximately equal to or greater than the amount of the number present in P700. P.V.E.

N64-15552* Maryland U., College Park, Md.
STUDY ON THEORETICAL AND EXPERIMENTAL RESEARCH ON GRAVITATIONAL RADIATION Semi-annual Progress Report, 1 Jul.-31 Dec. 1963
Joseph Weber [1963] 3 p refs
(NASA Grant NsG-436)
(NASA CR-55493) OTS: $1.10 ph, $0.80 mf

Theoretical investigations included: (1) An attempt to show that the nonexistence of cold, static equilibrium states for massive stars, which have exhausted their thermonuclear energy sources, is independent of the equation of state at densities much higher than nuclear density. (2) Calculations were developed based on the assumption that the pressure of a baryon gas is extremely small at densities above those at which reasonable estimates can be made. Experimental activities are concerned mainly with the developement of a gravimeter that is capable of a rocket landing on the lunar surface. P.V.E.

N64-15555 Gt. Brit. Ministry of Aviation, Mottingham Technical Information and Library Services
ON SCATTERING PROCESSES OF A HIGHER ORDER [UBER STREUPROZESSE HOHERER ORDNUNG]
P. Güttinger Jan. 1964 25 p refs Transl. into ENGLISH from Helv. Phys. Acta (Basel), v. 5, 1932 p 237–261
(TIL/T 5425)

Recent work in the field of radiation theory is reviewed. Processes are investigated in which two light quanta with frequencies ν_1 and ν_2 vanish, and a scattering light quantum $h\nu_3$ is newly formed. In the majority of cases, these processes are encountered only when $\nu_3 = \nu_1 + \nu_2 \pm \nu_{m,k}$, where $\nu_{m,k}$ corresponds to an atomic frequency. Author

N64-15559 European Atomic Energy Community, Brussels (Belgium)
A NANOSECOND TIME CODER WITH GREAT ANALYSIS RANGE FOR TIME-OF-FLIGHT EXPERIMENTS
P. Klopf, H. Meyer, W. Stüber, and H. Verelst Joint Nuclear Research Center, Central Nuclear Measurements Bureau, Geel Establishment (Belgium), Apr. 1963 22 p refs Presented at the Internatl. Colloq. on Nucl. Electronics, Paris, 25–27 Nov. 1963
(EUR-491.e) Available from Belgian American Bank and Trust Co., N.Y., Account No. 121.86: 40 Belg. Fr.

A first version of a nanosecond time coder for on-line and off-line time-of-flight analysis was built with the following main characteristics: smallest channel width, Δt min of one nanosecond; and maximum possible channel number for a time accuracy of one channel, greater than 2^{13} channels. A regulation system was developed to increase this value up to about 2^{18}. An overall differential accuracy of ± 0.15 nanosecond was reached for input pulses with a risetime up to 20 nanoseconds and a dynamic range of 10 max. The development results show the possibility of decreasing the smallest channel width down to 0.25 nanosecond for reliable function. The unit is a combination of a chronotron-type system with the classical Argonne system. Active elements used are tunnel diodes and transistors. Author

N64-15560 Brookhaven National Lab., Upton, N.Y.
NEUTRINO PHYSICS
Leon M. Lederman (Columbia U.) 9 Jan. 1963 26 p
(Sponsored by AEC)
(BNL-787 (T-300); *Its* Lecture Ser. 23) OTS: $0.50

A discussion of neutrino experimentation begins with an introduction to elementary particle physics and examines its evolution to the present state. Descriptions are given of the apparatus and equipment used in neutrino experiments, and the methods of study are investigated. C.L.W.

N64-15566 Brookhaven National Lab., Upton, N.Y.
NONLINEAR KINETICS OF A TWO-TEMPERATURE REACTOR
Louis M. Shotkin Aug. 1963 18 p refs
(BNL-815 (T-315)) OTS: $0.50

A nonlinear analysis of parameter regions in the "two-temperature" reactor stability problem is accomplished by using methods developed in the U.S.S.R. for treating ordinary differential equations. It is shown that in a model in which

both temperature-dependent quantities obey Newton's law of cooling, stable limit cycles exist and centers do not exist. If one of the quantities obeys an adiabatic cooling law, centers exist and stable limit cycles do not exist. A method is given for calculating the amplitude and frequency of limit cycles, as well as centers, which extends the Russian work. Solutions with finite escape time are found to exist for certain sets of parameters and initial conditions. When at least one linear characteristic root vanishes, it is shown that a first integral exists, and that it is possible to discuss reactor behavior in terms of this integral. Author

N64-15583 Air Force Cambridge Research Labs., Bedford, Mass. Electronic Material Sciences Lab.
ATOMISTIC EXPRESSION OF HARDNESS
J. N. Liendl and P. J. Gielisse Feb. 1963 26 p refs
(AFCRL-63-26; AD-430069)

Hardness of nonmetallic solids, defined as resistance against structure breakdown, has been reexamined for 88 solids of 22 different structures. The validity of the previously proposed volumetric cohesive energy, U/V, as a direct measure of hardness, has been more fully substantiated by additional data. The essential subdivision of solids into "hard core" and "soft core" could be more clearly defined. A formula is proposed that expresses hardness in terms of physical constants and measurable physical parameters only. The formula shows hardness to be directly proportional to the force constants, a structure factor, and the effective valency, but inversely proportional to the interatomic distance. This formulation has a direct bearing on problems, such as hardness anisotropy and solid solution hardness. Author

N64-15591 Carnegie Inst. of Tech., Pittsburgh, Pa.
LINEAR CHAIN ANTIFERROMAGNETISM IN $Mn(HCOO)_2 \cdot 2H_2O$
G. R. Wagner and S. A. Friedberg 10 p refs Submitted for Publication
(Contract Nonr 760(05))
(Tech. Rept. 18; AD-419758)

The magnetic susceptibility of powdered $Mn(HCOO)_2 \cdot 2H_2O$ was measured, and the results are given for temperature between 0.4° and 20° K. A description is given of a simple model of the magnetic structure of $Mn(HCOO)_2 \cdot 2H_2O$, which included the interactions between some of the Mn^{++} ions. The Heisenburg model, even in the classical limit, provides an adequate description of the susceptibility of Mn^{++} chains in $Mn(HCOO)_2 \cdot 2H_2O$. C.L.W.

N64-15602 Stanford Research Inst., Menlo Park, Calif.
QUANTUM VIRIAL EXPANSION
Felix T. Smith Repr. from Phys. Rev., v. 131, no. 6, 15 Sep. 1963 p 2803–2804 refs
(Supported by NSF)

The usual quantum mechanical cluster expansion in the theory of imperfect gases involves the trace of operators of the form $\exp(-H_n/kT)$, where H_n is then n-body Hamiltonian. It is shown here that this expansion is identical with the recently derived cluster expansion in terms of the collision lifetime matrices $Q_n(E)$, in which the characteristic terms involve the expressions $Tr[\exp(-E/kT)Q_n(E)]$. Author

N64-15610 European Organization for Nuclear Research, Geneva (Switzerland)
MAGNET SHIMMING. AN IBM-7090 CODE UTILIZING EMPIRICAL DATA TO OBTAIN OPTIMAL SHIMMING AND TRIMMING OF MAGNETS
Nils Vogt-Nilsen 6 Jan. 1964 19 p
(CERN-64-3)

The frequently encountered problem of producing a specified magnetic field within a given volume is rarely completely solved by the initial design of a magnet. It is usually necessary to correct the more or less rough field of the magnet by introducing appropriate shims or trimcoils. At any stage in the course of a shimming or trimming process the subsequent corrections to be tried are based on the mass of empirical data previously accumulated. The analysis of such data becomes increasingly complex for larger numbers of correcting elements. It is the object of the computer program described in the report to perform this analysis in such a manner that the optimal field corrections will always be obtained for a chosen number of correcting elements. Author

N64-15611 European Organization for Nuclear Research, Geneva (Switzerland)
LARGE-AREA PLASTIC SCINTILLATION COUNTER
E. Alleyn, H. Faissner, H. J. Gerber, E. Heer (Geneva U.), and M. Reinharz 1964 18 p refs
(CERN-64-4)

The construction and performance of a large-area plastic scintillation counter ($50 \times 80 \times 2$ cm^3) of especially simple design are described. Pulse-height spectra were measured with a beam of minimum ionizing particles hitting different points of the counter. The results are compared with theory. The percentage of light collection and the pulse height are calculated absolutely. The influence of magnetic fields on the performance was determined experimentally. Author

N64-15612 Los Alamos Scientific Lab., N. Mex.
INTRODUCTION TO THE PROPOSED LOS ALAMOS MESON PROJECT
Louis Rosen and D. E. Nagle 13 Jan. 1964 36 p
(Contract W-7405-eng-36)
(LAMS-3025) OTS: $0.75

A discussion is given concerning the feasibility, the uniqueness, and the importance of a meson facility for studies of nuclear structure and nuclear reactions. The facility advocated is a linear accelerator with a capability of generating 1-ma average current of 800-Mev protons with a 6% duty cycle. C.L.W.

N64-15616 European Organization for Nuclear Research, Geneva (Switzerland)
THE HIGH INTENSITY MUON BEAM WITH LOW PION CONTAMINATION AT THE CERN SYNCHRO-CYCLOTRON
A. Citron, M. Morpurgo, and H. Øveras 27 Nov. 1963 126 p refs
(CERN-63-35)

A system is described that yields a muon beam having both high intensity and high purity. It consists of: (1) a first-momentum analyzer that passes a very wide band of pion momenta, but has a sharp, lower passband limit; (2) a decay path; and (3) a second-momentum analyzer, of which the resolution is determined by experimental requirements. In order to obtain many muons, a decay path that is not too short when compared with the decay length is necessary. Large values found for the decay length and the decay angle indicate that the decay path must be fitted with focusing devices. The focusing system chosen consists of a large number of short quadrupole lenses, each lens being turned 90° with respect to the preceding one. The beam dynamics of the short quadrupole system is treated in detail. Also discussed are the focusing of the decay products, design figures in the short-lens approximation, matching of the channel to the cyclotron, pion, and electron contamination, and fluctuations of the pion contamination with channel current. E.K.R.

N64-15645 Naval Ordnance Lab., White Oak, Md.
ANALYTIC SOLUTIONS TO THE EQUATIONS OF MOTION OF MISSILES HAVING SIX DEGREES OF FREEDOM
W. E. De Grafft *In* Bur. of Naval Weapons Proc. of the 6th U.S. Navy Symp. on Aerobaliistics [1963] 64 p refs (See N64-15626 07-11)

Analytic solutions to the six-degree-of-freedom equations of motion for vehicles experiencing arbitrary changes in flight speed, spin rate, and atmospheric density are presented. These solutions are restricted to vehicles having a constant and symmetrical mass distribution about the longitudinal vehicle axis and constant linear aerodynamic coefficients. However, only the restriction of linear aerodynamic coefficients is required by the theory. The solution of the equation of angular motion is epicyclic, as in the case where the flight speed, spin rate, and atmospheric density are constant. The stability criteria derived here show that an acceleration in spin rate has a destabilizing effect on the nutational mode. An increase in the slope of the static-pitching-moment curve decreases the effects of spin-rate accelerations on the stability of the vehicle. Author

N64-15673 RAND Corp., Santa Monica, Calif.
PROPULSION BY A GASEOUS FISSION REACTOR Second Report
H. W. Hubbard, A. L. Latter, and E. A. Martinelli Oct. 1963 13 p refs
(Contract AT(04-3)-414)
(RM-3851-AEC)

An effect that is important in increasing the critical mass—the decrease in neutron mean free path due to the thermal motion of the deuterons—is discussed. The inclusion of this effect leads to a minimum U^{235} weight of more than 100 tons for the Mars mission. If plutonium is used, approximately 25 tons will be required. R.T.K.

N64-15684 California Research Corp., La Habra
REFLECTION AND TRANSMISSION OF PLANE COMPRESSIONAL WAVES Scientific Report No. 4
R. D. Tooley, T. W. Spencer, and H. F. Sagoci 19 Dec. 1963 707 p refs
(Contract AF 19(604)-8344)
(AFCRL-64-205; AD-429797)

The energy partition of a plane compressional wave impinging upon a plane interface is analyzed. The mathematical solution is presented and discussed, with particular emphasis on the nature of the transmitted waves when the angle of incidence exceeds the critical angle. Extensive tables of data are presented that cover a wide range of the input parameters. The data is discussed, and representative data samples are plotted. Author

N64-15690 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
CERTAIN PROBLEMS IN THE DYNAMICS OF A SYSTEM OF SOLID BODIES
A. I. Lur'ye 14 Jan. 1963 24 p refs Transl. into ENGLISH of a book "Trudy Leningrad. Politekhn. In-Ta.", no. 210, 1960 p 7-22
(FTD-TT-62-1152/1+2+4; AD-297571)

From the equation of motion of a solid body with respect to an inertial system of axes, the equations of motion of a system of solid bodies are determined. Applications of these equations are discussed. R.T.K.

N64-15710 General Dynamics/Fort Worth, Tex
THE COMPRESSION AND DEFORMATION OF LEAD SPHERES IN THE UNIRAM TETRAHEDRAL ULTRAHIGH PRESSURE DEVICE
R. D. Potter 15 Jan. 1964 14 p
(Contract AF 33(657)-11214)
(ERR-FW-211; AD-429825)

Small, lubricated lead shot was placed in close-packed layers in the UniRam and pressed to 52 kilobars pressure. The lead spheres were deformed into dodechedrons that revealed the uniformity of compressive and flow mechanisms in tetrahedron samples. The results indicate that overall uniformity is chiefly dependent upon alignment and symmetry of sample and anvils. It is also indicated that extruded webs are established from material along the edges and corners of the sample tetrahedron early in the pressurization cycle, and that such samples would be best when preformed with webs in place. Author

N64-15721 India. Dept. of Atomic Energy, Bombay
PERTURBATION THEORY OF MANY PARTICLE SYSTEMS, PART II
P. G. Khubchandani and C. Manohar 1963 16 p refs
(AEET/CD/19)

A perturbation theory is formulated that is valid for systems with discrete spectra and also for systems with continuous spectra. Van Hove's formulation is derived as a special case, and makes use of the diagram techniques. E.W.

N64-15723 Oklahoma U., Norman Research Inst.
THE PROPAGATION OF ULTRASONIC ELASTIC WAVES IN SOLID BODIES AND IN GRANULAR MEDIA Final Report
Norman H. Ricker Dec. 1963 57 p refs
(Contract AF 19(604)-8416; Proj. Vela-Uniform)
(AFCRL-63-932; AD-430191)

The current program-status summary includes the following: (1) The present understanding of the propagation and absorption of elastic waves in metals is described, and an analogy is set up between the structure of a metal and the structure of a granular medium in which the pore spaces are filled with a monatomic gas. (2) The techniques of preparing suitable granular media from fritted glass beads are described. (3) Two methods are described for determining the two constants of the Stokes wave equation. These methods are those making use of continuous sinusoidal waves and those making use of transient elastic waves. (4) A most satisfactory method has been developed for determining the velocity and absorption of elastic waves in granular media. (5) The thermal diffusivity apparatus for use not only at atmospheric pressure but also under vacuum, and with introduced gases, has been constructed. (6) Measurements of the thermal diffusivities of media composed of two sizes of glass beads have been made under various conditions of pore-space filling and evacuation. I.v.L.

N64-15728 Utah U., Salt Lake City Upper Air Research Lab.
RADIATION HARDENING THE STANDING WAVE IMPEDANCE PROBE Scientific Report No. 1
L. C. Howlett, J. P. Evans, and K. D. Baker 19 Dec. 1963 57 p refs
(Contract AF 19(628)-447; DASA-WEB-07.007)
(AFCRL-63-753; AD-429178)

The radiation hardening process for the Standing Wave Impedance Probe is discussed. Included in this process is the selection of radiation-resistant components on the basis of a literature search, gamma radiation testing, and neutron

radiation testing conducted by the Upper Air Research Laboratories. Indications were that many of the semiconductors, resistors, and insulators used in the original Impedance Probe were unreliable in a radiation environment, such as that encountered in the nuclear-powered Agena satellite 626. This environment is expected to consist of a yearly radiation dose of 5×10^{12} neutrons/cm^2 and 5×10^7 gamma rads. The choice of radiation-resistant components based on the literature search findings was substantiated by a gamma radiation test at 7.5×10^4 rad/hr and a neutron radiation test supplying a total dose of 4×10^{13} neutrons/cm^2. Author

N64-15729 Joint Publications Research Service, Washington, D.C.
PRODUCTION OF RADIOACTIVE ISOTOPES AT THE "BORIS KIDRIC" INSTITUTE IN VINCA
Cedomir Teofilovski 18 Feb. 1964 19 p refs Transl. into ENGLISH of an article from Tehnika (Belgrade), v. -19, no. 1, Jan. 1964 p 25–32
(JPRS-23279; OTS-64-21586) OTS: $0.50

The reactor, the radiochemical laboratory, the irradiation of materials, and the chemical–technological procedures applied in the production of radioisotopes are described. The radioisotopes produced are: Au^{198}, I^{131}, P^{32}, S^{35}, K^{42}, Na^{24}, Ba^{131}, Br^{82}, Ar^{41}, Tl^{204} Ir^{192}, (reactivated), and Co^{60}. The isotopes are used in medicine, industry, and research. I.v.L.

N64-15731 India. Dept. of Atomic Energy, Bombay
A COMPILATION OF DATA FOR ACTIVATION ANALYSIS BY THE(n,γ) REACTION
S. Gangadhara, R. Krishnamoorthy Iyer, and M. Sankar Das 1963 45 p refs
(AEET/ANAL/28)

A collection of available data dealing with activation analysis is presented in tabular form and provides the following information: (1) saturation activity of different radioisotopes produced by (n,γ) reaction, when 1 μg of an element is irradiated at a flux of 10^{12} n/cm^{2}sec (the "growth factor" for a specified period of irradiation is given separately); (2) the half-lives of the nuclides produced; (3) percentage of the total decay by different modes—beta emission, electron capture, and isometric transition; (4) the energies and intensities of gamma rays accompanying the decay; and (5) possibility of interference from reactions, like (n,p) and (n,α), which produce the same nuclide. P.V.E.

N64-15738 Frankford Arsenal, Philadelphia, Pa. Research and Development Group
FEASIBILITY STUDY OF AN EXPLOSIVELY ACTUATED FLASH PROTECTION DEVICE
F. Pisano Jan. 1964 17 p
(R-1640; AD-430250)

A study was conducted of an explosively actuated optical shutter that would be compatible with a flash protection system. The shutter was to close an optical aperture 6 3/4 inches long by 2 1/4 inches high within a time interval of 480 microseconds. A design was made, and two working models and ten shutters were fabricated. A search for the quickest acting detonator was made that resulted in the use of the T20E1 detonator. Preliminary tests were conducted, and high-speed motion pictures recorded the time and function on film. These tests indicated that a redesigned shutter and housing were required because of structural inadequacies. The next series of tests was conducted with the redesigned shutter and housing. In these tests, the explosive charge was increased in order to attain the specified time. Satisfactory performance was obtained in these tests. Author

N64-15739 Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
INFLUENCE OF ATMOSPHERIC TURBULENCE ON THE AUDIBILITY OF SOUNDS IN THE ATMOSPHERE
V. V. Bazilevich 17 Jan. 1964 12 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 73, 1958 p 50–53
(RSIC-121; AD-429830)

A mathematical evaluation of the influence of dynamic turbulence on the audibility of sounds in the atmosphere is presented. Both isotropic and homogeneous atmospheric turbulences are considered. P.V.E.

N64-15761 David Taylor Model Basin, Washington, D.C.
ANALYTICAL STUDY OF FORCED SHIP MOTIONS
Jack Kotik 20 Sep. 1963 50 p refs
(Contract Nonr-2692(00))
(TRG-126-FR-A; AD-427841)

The Kramers–Kronig relations were extended to the case of forward speed and cross coupling, in the absence of negative damping. Some initial steps were taken in the direction of calculating hi-fi damping coefficients for heaving ellipsoids. The behavior of damping coefficients at low frequency, for asymmetric motions, was investigated in its own right and in connection with the hi-fi method. It was shown that, with zero speed, the cross-coupling coefficients can be found from the wave amplitudes in the forced motion problems. A new kind of slender-body theory for ship motions was considered. Author

N64-15769 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ELECTRON PARAMAGNETIC RESONANCE
S. A. Al'tshuler and B. M. Kozyrev 14 Jan. 1963 475 p refs Transl. into ENGLISH of the book "Elektronnyy Paramagnitnyy Rezonans" Moscow, Gos. Izd. Fiz.-Mat. Lit., 1961 368 p refs
(FTD-TT-62-1086; AD-295794)

A complete survey is given of research in the field of electron paramagnetic resonance. The most detailed treatment is given to the theoretical and experimental results pertaining to ionic crystals. All basic literature on electron paramagnetic resonance up to 1959 is covered. C.L.W.

N64-15771 Du Pont de Nemours (E. I.) and Co., Aiken, S. C.
THORIUM-FUELED D_2O-MODERATED POWER REACTORS
Dale F. Babcock, Ramon R. Hood, and Daniel S. St. John, comps. Dec. 1963 42 p refs
(Contract AT(07-2)-1)
(DP-864) OTS: $1.00

This report contains an appraisal of the current technological status of D_2O-moderated reactors that are fueled with thorium; also included is a description of the research and development program that would be required for a demonstration of U^{233} breeding in a D_2O-moderated prototype power reactor. It is concluded that U.S. development of D_2O-moderated reactors should be continued so as to realize the following attributes of such reactors: (1) breeding with thorium in a reactor that can produce economical electric power; and (2) greater extension of U.S. uranium reserves than with any converter–breeder combination proposed to data. Author

N64-15772 Kyoto U. (Japan) Research Inst. for Fundamental Physics
p-p SCATTERING AT 660 MEV – MODIFIED ANALYSIS
Yogiro Hama and Norio Hoshizaki Dec. 1963 14 p refs
(RIFR-30)

The results of a phase shift analysis of p-p scattering data at 660 Mev are reported. It is suggested that the effect of the LS interaction in the current potential models must be strongly reduced in ^3F states. Author

N64-15773 Kyoto U. (Japan) Research Inst. for Fundamental Physics
P-P SCATTERING AT 970 MEV
Yogiro Hama and Norio Hoshizaki Dec. 1963 18 p refs
(RIFP-31)

The results of a phase shift analysis of p-p scattering data at 970 Mev are reported. Although the data do not determine a unique set of phase shifts, the plausible requirement that the real phase shifts be of the Stapp No. 1 type leads to two types of solutions. It is shown that measurements of several triple scattering parameters can discriminate between these two solution types. Author

N64-15777 Stanford U., Calif. Linear Accelerator Center
1963 SUMMER STUDY REPORT, PART I
K. Berkelman (Cornell U.), G. R. Bishop (Lab. Accélerateur Linéare, France), C. de Vries (Inst. Kernphys. Onderzoek, Neth.), G. Feldman (Johns Hopkins U.), and D. B. Isabelle (NBS) et al [1963] 211 p refs
(Contract AT(04-3)-400; Contract AT(04-3)-476)
(SLAC-25 (Pt. 1)) OTS: $3.00

Papers are presented that discuss research in particle physics. Some of the research areas were: a comparison of pion fluxes expected at SLAC with estimates of those produced at the Brookhaven Labs; an analysis of weak interactions in terms of Yukawa interactions; studies of the different types of classical beam monitors used in conjunction with linear accelerators; discussions of the energy, angle, and spatial distribution of positrons emerging from the radiator of an accelerator, and the beam transport problem from the radiator to the beam switchyard; investigation of three methods of obtaining beams of monochromatic photons; and elastic electron–proton scattering kinematics. C.L.W.

N64-15779* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
THERMAL AND THERMOELECTRIC PROPERTIES OF FERROMAGNETIC METALS
A. I. Rezanov 20 Jan. 1964 6 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 82, no. 6, 1952 p 885–887
(NASA Contract NAS7-100)
(NASA CR-53070; Internal Office Mem. T-37) OTS: $1.10 ph, $0.80 mf

By expressing the kinetic equation in the usual form and making use of the second approximation to calculate the integrals of antisymmetrical quantum statistics, as well as to calculate the dependence of the effective mass, chemical potential, energy, and mean-free-path traversal time of the outer electrons on the spontaneous magnetization, the equations for the Thomson coefficient and Peltier heat value were obtained. It was demonstrated from all of the derived equations that the temperature dependence of the ferromagnetic "perturbations" of the investigated variables is determined by the square of the spontaneous magnetization, whereas the temperature coefficients corresponding to each of these variables exhibit a strong maximum near Curie point. R.T.K.

N64-15810 University of Southern Calif., Los Angeles School of Engineering
AN APPLICATION OF SOMMERFELD'S COMPLEX ORDER WAVE FUNCTIONS TO THE PROBLEM OF RADIATION FROM A DIELECTRIC COATED CONE
Cavour W. H. Yeh Feb. 1963 18 p refs
(Contract AF 19(604)-6195)
(AFCRL-63-47; USCEC-82-209; EE-19; AD-404168)

Using the orthogonality relations of Sommerfeld's complex-order wave functions, the exact solution for the problem of electromagnetic radiation from a circularly symmetric slot on the conducting surface of a dielectric coated cone is obtained. The results are valid for the near zone region as well as for the far zone region, and they are applicable for arbitrary angle cones. It is noted that the technique used to solve this problem may be applied to similar types of problems involving conical structure, such as the diffraction of waves by a dielectric coated spherically tipped cone. Author

N64-15836 Hanford Atomic Products Operation, Richland, Wash.
METALLOGRAPHIC APPLICATION OF A THIN PLASTIC COATING ON RADIOACTIVE AND/OR CHEMICALLY ACTIVE MATERIALS: PLUTONIUM
G. E. Miller and T. K. Bierlein Dec. 1963 10 p refs
(Contract AT(45-1)-1350)
(HW-79845)

The advantage of using a thin, adherent plastic coating on metallographic specimens of plutonium was investigated. A plastic coating of formvar (polyvinyl formal) was found to retard oxidation and was effective in containing the radioactive contamination. In addition, it improved image resolution and contrast. R.T.K.

N64-15842* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
RELATION BETWEEN THERMAL CONDUCTIVITY AND VISCOSITY FOR NONPOLAR GASES. II. ROTATIONAL RELAXATION OF POLYATOMIC MOLECULES
Cleveland O'Neal, Jr. and Richard S. Brokaw Repr. from Phys. Fluids, v. 6, no. 12, Dec. 1963 p 1675–1682 refs
(NASA RP-134)

The dimensionless ratio $f = \lambda M/\eta C_\mu$ relating the thermal conductivity, molecular weight, viscosity, and constant volume molar heat capacity has been determined for several nonpolar polyatomic gases at near-room temperature (270° to 295° K). The experimental method provides a direct determination of f by measurement of the subsonic temperature recovery factor. A recent theory has been used to calculate collision numbers for rotational relaxation from the experimental data as follows: Ch_4, 9.4; CF_4, 3.0; SF_6, 2.5; C_2H_4, 2.4; C_2H_6, 4.0; O_2, 12; N_2, 7.3; CO_2, 2.4; and C_2H_2, 1.8. In general, collision numbers for rotational relaxation are determined by the following factors: (1) the molecular mass distribution, (2) the strength of the intermolecular attractive forces, and (3) the molecular asymmetry. Author

N64-15850 Brookhaven National Lab., Upton, N.Y.
NUCLEAR ENGINEERING DEPARTMENT PROGRESS REPORT, MAY 1–AUGUST 31, 1963
Warren E. Winsche and F. T. Miles [Dec. 1963] 110 p refs
(BNL-823(S-65)) OTS: $2.25

The settled bed reactor concept was selected as a promising approach in the investigation and development of large power-producing reactor systems featuring the use of fuel in particulate form. The development of this concept encompasses

the following areas of investigation: fuel properties, theoretical and experimental physics, bed characteristics, and engineering, metallurgy, and corrosion. C.L.W.

N64-15851 Oak Ridge National Lab., Tenn.
OUTGASSING BEHAVIOR OF EGCR MODERATOR GRAPHITE
J. P. Blakely and L. G. Overholser Feb. 1964 45 p refs
(Contract W-7405-eng-26)
(ORNL-3560) OTS: $1.25

The outgassing characteristics of specimens of the EGCR moderator graphite stock have been determined in vacuo to a maximum temperature of 1,000° C using external resistance heating and to 1,800° C by induction heating. The specimens examined were cut from several locations in two of the 18-in. × 18-in. × 20-ft graphite bars that had been prepared under fabrication conditions comparable to those used for the graphite columns present in the Experimental Gas-Cooled Reactor. Data are given that show the effect of the position of sampling of the bars on the density of the graphite. The volume and composition of desorbates obtained at 300°, 600°, and 1,000° C as a function of specimen size and position of specimen within the bars also are given. The volume and composition of the desorbates obtained at 1,000°, 1,400°, and 1,800° C using induction heating are tabulated. Author

N64-15854 Mound Lab., Miamisburg, Ohio
MOUND LABORATORY PROGRESS REPORT FOR MARCH, 1963
J. F. Eichelberger, G. R. Grove, L. V. Jones, and E. A. Rembold 30 Mar. 1963 24 p refs
(Contract AT-33-1-GEN-53)
(MLM-1152)

Methods of isotope separation and purification are studied, and basic and applied research is conducted on a number of radioelements to determine the physical properties, to develop analytical techniques, and to study the basic radiochemistry involved. Of particular interest are the alpha emitters, their decay chains, their isotopes, and their chemical homologs. Methods are also studied for analyzing elements and compounds in support of other research. C.L.W.

N64-15876* General Motors Corp., Santa Barbara, Calif. Defense Research Labs.
AN INVESTIGATION OF THE PHENOMENA OF IMPACT FLASH AND ITS POTENTIAL USE AS A HIT DETECTION AND TARGET DISCRIMINATION TECHNIQUE
J. W. Gehring and R. L. Warnica Apr. 1963 55 p refs Presented at the 6th Hypervelocity Impact Symp., Cleveland, Apr. 30–May 2, 1963
(NASA Contract NAS7-100; JPL Contract 950299; and AFO8(635-2783)

The results of an experimental research program to provide data on the impact radiation associated with the collision of a projectile and a target are presented. This paper analyzes the phenomenon of impact flash and examines its potential use in two areas: (1) estimation of the impact flash likely to be observed on impact of a lunar probe on the moon's surface, and correlation of impact flash measurements made of an actual lunar impact with physical characteristics of the lunar surface; and (2) selection of hypervelocity impact flash phenomena, which may be remotely observed and which could provide significant information for determining the occurrence of a collision, the damage inflicted upon the target (satellite, ICBM, decoy, etc.), and possibly the identification of the target material. Author

N64-15897* Lockheed Missiles and Space Co., Sunnyvale, Calif.
ELECTROLYTIC PREPARATION OF HIGH DIELECTRIC THIN FILMS Quarterly Report, 27 Sep.–Dec. 1963
S. A. Ring 1963 31 p refs
(NASA Contract NASw-765)
(NASA CR-55495) OTS: $3.60 ph, $1.13 mf

Results are reported for the anodization of niobium substrates in baths containing lead, cadmium, and ethyl acid phosphate, titanium substrates in baths containing lead and barium, zirconium substrates in baths containing lead, and all three substrates in a number of other baths. Titanium strips anodized in baths containing soluble lead species yielded films exhibiting higher capacity–voltage products than might be expected for single oxide component films. Niobium strips anodized at low forming potentials in basic pumbite baths produced thick films consisting of a conducting layer over a capacitive layer. These films exhibited breakdown potentials higher than their forming potentials. Anodized niobium films contacted with potassium hydroxide and anodized titanium films contacted with brium hydroxide gave reactions indicating the possible formation of the corresponding niobate or titanate. Author

N64-15913 Nuklearni Institut Jozef Stefan, Ljubljana (Yugoslavia)
COMPARISON OF SPECTRA FROM Al^{27} (n,γ) Al^{28} AND Al^{27} (d,p) Al^{28}
F. Cvelbar, A. Hudoklin, M. Najzer, and V. Ramsak Oct. 1963 7 p refs Presented at the Yugoslav-Polish Symp., Krakow, May 1963
(NIJS-R-420)

Results of measurements of the gamma-ray spectrum from the radiative capture of 14 Mev neutrons in Al^{27} are discussed. A comparison was made of the 14 Mev neutron-capture gamma-ray spectrum from the $Al^{27}(n,\gamma)Al^{28}$ reaction with the proton spectrum from the $Al^{27}(d,p)$ Al^{28} reaction. R.T.K.

N64-15931* Israel Program for Scientific Translations, Ltd., Jerusalem
A COURSE IN THEORETICAL MECHANICS
A. A. Kosmodem'yanskii 1963 545 p refs Transl. into ENGLISH of the book "Kurs teoreticheskoi Mekhaniki" Moscow, Gos. Ucheb.-Ped. Izd. Min. Prosveshcheniya RSFSR, 1955
(NASA TT F-8015; OTS-62-11002) OTS: $5.25

The course has been divided into a study of kinematics and kinetics, which presents more problems in dynamics and focuses attention upon the problems. The unification of the problems of dynamics with the problems of equilibrium has resulted in clearer, more rigorous proofs to the theorems of statics. Considerable attention is given to analytical mechanics. The generalized equations of mechanics are examined along with the basic methods of integration. C.L.W.

N64-15933 Atomic Energy Commission, Washington, D.C. Div. of Tech. Information
INTERACTION OF ATOMIC PARTICLES WITH THE SURFACE OF A METAL
U. A. Arifov Nov. 1963 324 p refs Transl. into ENGLISH from a publ. of the Publishing House of the Acad. of Sci., Uzbek. SSR, 1961
(AEC-TR-6089) OTS: $4.00

The topics discussed are: (1) experimental and theoretical investigations of secondary processes in the interaction between atomic particles and the surface of a metal; (2) research using the static (galvanometer) method on secondary processes

occurring during bombardment; (3) oscillographic double modulation method for the investigation of secondary processes in the bombardment of metals with atomic particles; (4) the double-modulation method of secondary processes occurring in the bombardment of metals by positive alkali ions; (5) secondary processes occurring upon bombardment of metallic films by positive ions; (6) secondary processes produced by atomic particles at high metal temperatures, and the process of thermoelectronic emission; (7) secondary processes occurring upon bombardment of metals by ions of inert gases; (8) secondary processes occurring upon bombardment of metals with neutral atoms; (9) oscillographic investigations of adsorption, evaporation, and ionization of atoms on surfaces of metals; and (10) theoretical investigations of processes occurring upon interaction of atomic particles with the surface of a metal. R.T.K.

N64-15942 General Electric Co., Philadelphia, Pa. Space Sciences Lab.
SOME ASPECTS OF TURBULENT SCATTERING OF ELECTROMAGNETIC WAVES BY HYPERSONIC WAKE FLOWS
K. T. Yen Dec. 1963 40 p refs
(Contract DA-30-069-ORD-1955)
(R63SD58; AD-429172)

Effects of flow intermittency, nonisotropy of the turbulence structure, and finite width of the wake on the scattering cross section in its frequency and aspect-angle dependence are of primary concern. Phenomenological consideration of the physical process by which the turbulent electron-density fluctuations are likely to be produced in hypersonic wakes yields an expression for the intensity of the fluctuations in terms of the gradient of the mean electron-density distribution, the intensity of the turbulent velocity fluctuation, and a turbulence scale of the turbulent velocity field. Application of these considerations to turbulent scattering by underdense wakes has been made. In contrast to the ionospheric scattering, two contributions to the scattering cross section are obtained in the present case: the first one arises from the intermittency phenomenon and vanishes if the intermittency is omitted, and the second one is due to "turbulent" fluctuations. Author

N64-15954 California U., La Jolla
A PROOF THAT THE FREE ENERGY OF A SPIN SYSTEM IS EXTENSIVE Technical Report No. 17
Robert B. Griffiths 13 Jan. 1964 31 p refs
(Contract Nonr-2216(11))
(AD-429544)

The free energy obtained from the canonical partition function for a finite spin system possesses a certain convexity property, of which theorems by Peierls and Bogoliubov are particular applications. This property is used in proving the following result: the free energy of a spin system in a regular lattice, divided by the number of spins, converges to a definite limit as the system becomes infinite (in such a way that the surface-to-volume ratio goes to zero). The limit is not influenced by certain common types of boundary conditions. A similar result, but with convergence understood in a weaker sense, holds for derivatives of the free energy such as entropy, magnetization, and specific heat. In the proof, it is necessary to assume that the Hamiltonian has the translational symmetry of the spin system, and that long-range interactions decrease sufficiently rapidly with the distance r between spins. Author

N64-15957 Princeton U., N.J. Frick Chemical Lab.
ON THE THEORY OF RATES OF DISSOCIATION AND RECOMBINATION OF DIATOMIC MOLECULES Technical Report No. 5
Neil S. Snider 1 Jan. 1964 119 p refs
(Contract Nonr 1858(26))
(AD-429188)

This work dealt mainly with two problems in the theory of rates of dissociation and recombination of diatomic molecules. The first problem was to make a quantitative statement of the conditions under which it is valid to say that $k_d/k_r = K_d$ where k_d and k_r are the rate constants for nonequilibrium dissociation and recombination and K_d is the thermodynamic equilibrium constant for the reaction. The second problem was to determine the effect on k_d of the variation of transition probabilities and vibrational level spacings with the angular momentum of the molecule. R.T.K.

N64-15975* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
NOISE CONSIDERATIONS IN THE DESIGN AND OPERATION OF AIRCRAFT
Arthur A. Regier Repr. from Proc. of the Seminar on Aeron. Sci., Nov. 27–Dec. 2, 1961 26 p refs
(NASA-RP-137)

Aircraft noise problems are reviewed and include the generation and transmission of noise, and the response of humans and structures to the noise. The research on noise sources during the last decade is reviewed briefly. The noise sources discussed are propellers, inlet and exhaust of jet-engines, boundary layers, and the sonic booms. Author

N64-15987 Hungarian Academy of Sciences, Budapest Central Research Inst. of Physics
DIRECT EFFECTS IN /p,γ/ REACTIONS
Ilona Fodor, I. Berkes, I. Demeter, I. Dezsi, and L. Keszthelyi 1963 14 p refs
(KFKI 14/1963)

The $B^{11}/p,\gamma/C^{12}$ reaction was studied, and a number of experiments at the resonance level of $E_p = 163$ kev of bombarding proton energy were conducted. R.T.K.

N64-15988 Hungarian Academy of Sciences, Budapest Central Research Inst. of Physics
THE ANGULAR DISTRIBUTION OF γ-RAYS FROM THE FISSION OF U^{238}
S. Desi, G. Graff, A. Lajtai and L. Nagy 1963 6 p refs
(KFKI-16/1963)

The gamma ray intensity from slow neutron fission was found to be larger in the direction of the fission fragment motion than when normal to it. This phenomenon was assumed to be due to a rather large angular momentum of the fission fragments, correlated with the fission axis, acquired at the moment of scission and caused by noncolinear Coulomb repulsion between the fragments. Equipment and procedures are described that were utilized in the experimental investigation of this phenomenon. The intensities of the gamma rays were measured at 90°, 112.5°, 135°, 157.5°, and 180° to the fragment direction. The angular position was varied after every 10^6 counts to average the errors due to various fluctuations. C.L.W.

N64-15989 Hungarian Academy of Sciences, Budapest Central Research Inst. of Physics
SHELL MODEL STUDY OF Cl^{36} AND A^{36} NUCLEI
I. Lovas and J. Revai 16 Sep. 1963 12 p refs
(KFKI-1491/F)

By means of the shell model, the properties and eigenvectors of the low lying levels in Cl^{36} and A^{36} nuclei have been determined, taking into account configuration mixing.

The Rosenfeld-type exchange force has led to a full contradiction between calculated and experimental data, but the Serber force has given rather good agreement. The magnetic moment of Cl^{36} ground state has been calculated using the eigenvectors obtained from the energy matrix diagonalization. Making use of the available experimental data and the results of the calculations, a consistent level scheme of Cl^{36} has been constructed. Author

N64-15995* Oak Ridge National Lab., Tenn.
SPACE VEHICLE SHIELDING STUDIES. PART III: THE ATTENUATION OF A PARTICULAR SOLAR FLARE BY AN ALUMINUM SHIELD
R. G. Alsmiller, Jr. and J. E. Murphy 20 Feb. 1964 8 p refs
(Sponsored by NASA; Contract W-7504-eng-26)
(ORNL-3549) OTS: $0.50

Using the straight-ahead approximation, nucleon–meson cascade calculations have been carried out for a particular solar-flare proton spectrum incident on a shield. The shielding material has approximately the properties of aluminum. Both spherical-shell and slab geometries are considered. Author

N64-15998 Hanford Atomic Products Operation, Richland, Wash.
AN ALPHA SCINTILLATION TESTER FOR URANIUM SURFACE CONTAMINATION OF N-REACTOR FUEL
C. N. Jackson, Jr. 7 Feb. 1964 24 p ref
(Contract AT(45-1)-1350)
(HW-78268) OTS: $0.75

This report describes a nondestructive tester and some of its applications in measuring 10 to 100 μg of uranium surface contamination on unirradiated, low enrichment, uranium fuel elements. The fuel elements will be used in N-Reactor, a dual-purpose, power generating reactor being constructed. The tester uses a zinc-sulfide scintillation system that detects the natural alpha decay of uranium. It can test 118 $in.^2$ of surface at one time in a counting period of 10 min with a sensitivity of 13×10^{-9} g/cm^2. Various tradeoffs between statistical reliability and counting time (6 min or less) are worked out for a go, no-go type of testing. The tester's use in measuring the contamination on production fuel elements and in pinpointing the manufacturing operations that have caused contamination is described. Author

N64-16001 General Electric Co., Cincinnati, Ohio Flight Propulsion Lab. Dept.
THIRD ANNUAL REPORT HIGH-TEMPERATURE MATERIALS AND REACTOR COMPONENT DEVELOPMENT PROGRAMS. VOLUME III: INSTRUMENTATION AND CONTROLS
28 Feb. 1964 45 p refs
(Contract AT(40-1)-2847)
(GEMP-270C) OTS: $1.0

This volume covers five reactor instrumentation and controls programs: circulating-ball reactivity control with capability of operating around sharp bends; static switching utilizing solid-state devices; capacitance temperature sensor based on the change in dielectric constant of alumina or beryllia versus temperature change; high-temperature extension of conventional nuclear sensors; development of nuclear sensors for monitoring and controlling high-temperature, high-performance reactors. Significant results achieved on these programs are as follows: (1) A shim–scram actuator was designed incorporating an electromagnetic drive for shim and scram, a shim speed limiting device, and a force feedback position indicator. (2) A three-channel trip circuit and a two-out-of-three logic circuit using controlled switches in place of transistors were designed, built, and tested. (3) A capacitance-type temperature sensor was operated in an inert atmosphere at temperatures up to 2,083° C(3,782° F). Models of a gridded and a compensated a.c. ionization chamber were tested in both thermal neutron and gamma environments. Author

N64-16003 Oak Ridge National Lab., Tenn.
PHASE MOTION OF IONS IN ISOCHRONOUS CYCLOTRONS
F. M. Russell Jan. 1963 36 p refs
(Contract W-7405-eng-26)
(ORNL-3444) OTS: $0.75

The motion in phase of ions in isochronous cyclotrons possessing nonradial accelerating gaps is examined, and it is shown that under certain conditions a quasi-phase-stable state is possible. By differentially modulating the gap voltage with radius in adjacent gaps and slightly perturbing the magnetic field, it is possible to focus ions upon a chosen phase angle. The major advantages associated with such a scheme are the reductions in sensitivity of the phase of ions to errors in the magnetic field and to gap voltage variations. The possibility of controlling the phases of ions by using extra electrodes also is examined; it is shown that large phase compression could be achieved under certain conditions. Author

N64-16017 Union Carbide Nuclear Co., Oak Ridge, Tenn.
ISOTROPIC RATIO MEASUREMENT ERRORS CAUSED BY ION INTERACTIONS WITH IMPURITY MOLECULES
V. L. Warren and J. C. Horton 14 Feb. 1964 23 p refs
(Contract W-7405-eng-26)
(K-1400) OTS: $0.50

Impurities or residual gases in the ion source and/or analyzer region of a mass spectrometer cause errors in the measurement of isotopic ratios. The effect in uranium hexafluoride analyses is studied. This apparent ratio change is due to ion-beam distortion produced by ion–molecule interactions. Both symmetrical and nonsymmetrical ion-beam spread are observed and attributed primarily to small-angle elastic scattering with energy loss. Charge exchange, ionization by positive ion impact, partial beam neutralization, and other effects do not seem to contribute significantly. Author

N64-16018 Atomic Energy Commission, Washington, D.C. Div. of Technical Information
ISOTOPES TECHNOLOGY DEVELOPMENT PROGRAM, FIFTH ANNUAL CONTRACTORS MEETING HELD IN WASHINGTON, D.C., DECEMBER 2 AND 3, 1963
Oscar M. Bizzell et al Feb. 1964 70 p refs
(TID-7681) OTS: $1.75

Emphasis was placed on research and development as directed primarily toward filling critical gaps in advancement in the use of isotopes. This isotope technology research has a direct relationship to problems of public concern. These include the areas of water resources, weather, air pollution, industrial-waste treatment and disposal, and ultimate industrial applications. C.L.W.

N64-16025 Columbia U., New York, N.Y. Radiological Research Lab.
STATISTICAL FLUCTUATIONS IN THE ENERGY LOSS OF 5.8 MEV ALPHA PARTICLES PASSING THROUGH AN ABSORBER OF VARIABLE THICKNESS
Walter Rosenzweig (Ph.D. Thesis–1960) and Harald H. Rossi Washington, AEC Div. of Tech. Inform., 1 Nov. 1963 101 p refs
(Contract AT(30-1)-2740)
(NYO-10716) OTS: $2.25

The measurements were performed with a proportional counter designed to allow a selected portion of the counting gas to serve as the absorber. The important distinction between the amount of energy lost by the ionizing particle in a given traversal of the absorber as compared to the energy deposited in the absorber is discussed, and a method is described that allows the measurement of the fluctuations of both types of events. The experimental results are presented as frequency distributions of both energy loss and energy deposition for a series of operating conditions in which the average alpha-particle energy losses varied from 90.8 kev to 3.02 kev. In order to allow comparison between the experimental results and theory, the problem of counter resolution had to be examined in detail. This was done in an experimental study, utilizing monoenergetic X-rays, the results of which are described.
Author

N64-16037 Boston U., Mass.
A SPINOR FORMULATION OF ELECTROMAGNETIC THEORY IN GENERAL RELATIVITY Scientific Report No. 1
Mendel Sachs 31 Dec. 1963 22 p refs
(Contract AF 19(628)-2816)
(AFCRL-64-8; AD-430580)

The spinor formulation of the Maxwell–Lorentz theory is extended to a generally covariant formalism. The underlying group for electrodynamics is thereby generalized from the proper inhomogeneous Lorentz group L_p to a special topological group T. It follows from the physical assumptions of this theory that the group T must be locally compact, connected, and must satisfy the second axiom of countability. The invariants and conservation laws of the generalized theory are derived, and a correspondence of some of them with those of the conventional theory is demonstrated.
Author

N64-16044 RAND Corp., Santa Monica, Calif.
CLOSE-IN ELECTROMAGNETIC FIELDS PRODUCED BY NUCLEAR EXPLOSIONS
W. Sollfrey Apr. 1963 36 p refs
(Contract AF 49(638)-700; Project RAND)
(RM-3525-PR; AD-404917)

The close-in electromagnetic fields produced by deflection in the earth's field of Compton electrons from a nuclear explosion are analyzed. Maxwell's equations in spherical coordinates are solved by an expansion in the perturbation fields, taking into account the space and time dependence of the conductivity and Compton current. The field structure is determined, and it is shown that the peak change in field is only 10 percent.
Author

N64-16050 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ON THE MECHANISM OF THE PROCESS OF MAGNETICALLY TREATING WATER
A. N. Kirgintsev, V. M. Sokolov, and N. I. Burlakova 10 Oct. 1963 13 p refs Transl. into ENGLISH from Izv. Sibirsk. Otd. Akad. Nauk SSSR (Novosibirsk), no. 1, 1963 p 25–31
(FTD-TT-63-964/1+2; AD-423209)

A study was made of the kind and amounts of corrosion products that are acquired by water and of the extent to which these products affect sludge formation.
R.T.K.

N64-16051 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
THE INDIUM-GALLIUM RADIATION LOOP OF THE IRT NUCLEAR REACTOR
A. Kh. Breger, Yu. S. Ryabukhin et al 26 Jul. 1963 16 p refs Transl. into ENGLISH from a Russian rept. Presented at the Intern. Conf. on the Use of Large Radiation Sources, Warsaw, 8–12 Sep. 1959
(FTD-TT-63-553/1+2+4; AD-427395)

On the basis of the general theory formulated by Ryabukhin and Breger, a radiation loop for the IRT nuclear reactor was developed. In this loop, the γ-activity carriers are a eutectic alloy of indium and gallium.
R.T.K.

N64-16058 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ON THE STRENGTH OF THICK-WALLED CYLINDRICAL AND HOLLOW SPHERICAL SHELLS EXPOSED TO IRRADIATION
A. A. Il'yushin and P. M. Ogibalov 25 Oct 1962 18 p refs Transl. into ENGLISH from Inzh. Sb. (Moscow), v. 28, 1960 p 134–144
(FTD-TT-62-719/1+2+4; AD-292218)

The dependence of the modulus of elasticity, the yield point, the tensile strength, and the entire stress–strain diagram on the total flux nvt was studied experimentally after irradiation of the specimens (annealed austenitic stainless steel and silicon–carbon steel) in a nuclear reactor.
R.T.K.

N64-16083 RAND Corp., Santa Monica, Calif.
MONTE CARLO CALCULATIONS OF THE TRANSPORT OF 14 MEV NEUTRONS IN THE ATMOSPHERE
J. I. Marcum Apr. 1963 124 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-3531-PR; AD-405041)

Two corrections have been made to the neutron Monte Carlo transport code, and curves from several previous reports are presented along with the new results given by the corrected code, so that comparisons can be made and the previous incorrect results can be changed. For the first time, results are given for the transport of 14 Mev neutrons near an air–ground interface and also in an infinite homogeneous air medium. An auxiliary smoothing and graphing code has been developed for use in conjunction with the Monte Carlo transport code. This code is described and sample results are shown.
Author

N64-16084 Army Missile Command, Redstone Arsenal, Ala. Redstone Scientific Information Center
PROCEDURE IN CORRECTING FOR MATRIX EFFECTS IN FLUORESCENT X-RAY ANALYSIS, PART II
Masakatsu Sugimoto 7 Feb. 1964 19 p refs Transl. into ENGLISH from Bunseki Kaguku (Japan), v. 12, 1963 p 475–483
(RSIC-130; AD-430423)

This paper describes correction equations that were derived from the composition-K X-ray intensity relation described in the previous paper. These equations are well suited for practical routine work, and give results that are quite accurate. The W_j in the equation $W_i = I_i\,(\hat{\mu}_{iO} + \Sigma\hat{\mu}_{ij}W_j)$ in the previous paper was replaced by I_j to give $W_i = I_i(A_{iO} + \Sigma A_{ij}I_j)$ from which the approximation $W_i = k_i(I_i + \Sigma a_{ij} \cdot I_j)$ was derived. a_{ij} is an approximation; therefore, it is different from $\hat{\mu}_{ij}$. However, it does not lose its relative applicability. Although this correction does not concern itself with a slope correction, it is applicable over a considerable range.
Author

N64-16085 Massachusetts U., Amherst Polymer Research Inst.
ON THE ORIENTATION MECHANISM OF CRYSTALLINE POLYMERS

R. S. Stein and K. Sasaguri 4 Sep. 1963 37 p refs
(Contract Nonr-3357(01))
(ONR-TR-64; AD-430356)

A mathematical crystal-reorientation model dealing with the variation in orientation accompanying the elongation of polyolefin films (polyethylene) is discussed. The orientation of individual crystal axes is accounted for in detail. The effect of chain unfolding or crystal rotation within the spherulite is considered. The model successfully accounts for the variation of birefringence and crystal orientation functions with elongation that is found experimentally. I.v.L.

N64-16102 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SELF-EXCITED OSCILLATIONS
A. A. Kharkevich 9 Dec. 1963 187 p refs Transl. into ENGLISH of the book "Avtokolebaniya" Moscow, Gos. Izd. Tekhn.-Teor. Lit., 1953 p 1–170
(FTD-TT-63-748/1+2; AD-427393)

This book contains a discussion of the physical bases for self-excited oscillations. The discussion, given without mathematical analysis, is based on energy considerations. The volume considers examples of self-excited oscillations encountered in physics and in engineering. R.T.K.

24 PHYSICS, PLASMA

Includes fusion; and magnetohydrodynamics. *For related information see*: 05 Astronomy and Astrophysics; 23 Physics, General; and 25 Physics, Solid-State.

N64-15048* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
RADIATION FROM SLOTTED-CYLINDER ANTENNAS IN A REENTRY PLASMA ENVIRONMENT
Calvin T. Swift Washington, NASA, Feb. 1964 62 p refs
(NASA TN-D-2187) OTS: $1.75

A method is presented for calculating the equatorial patterns of slot antennas on conducting cylinders coated with plasmas that are inhomogeneous in a direction radially outward from the cylinder. The procedure consists of separating the wave equation into real and imaginary parts and numerically integrating between appropriate boundary conditions. The solutions are coefficients of the Fourier series that express the nature of the far-field pattern. The results differ from those obtained by plane-wave theory and demonstrate the desirability of this approach to predict signal attenuation of antennas in a radially varying plasma environment. Procedures are outlined for solution of problems involving scattering, antenna arrays, and an aspect of the near-field problem. Author

N64-15197* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
EFFECT OF SEEDING AND ION SLIP ON ELECTRON HEATING IN A MAGNETOHYDRODYNAMIC GENERATOR
Frederic A. Lyman, Arthur W. Goldstein, and John E. Heighway Washington, NASA, Feb. 1964 46 p refs Presented at the 4th Symp. on Eng. Aspects of Magnetohydrodyn., Berkeley, Calif., 10–11 Apr. 1963
(NASA TN-D-2118) OTS: $1.25

The influence of electron–ion collisions on the attainment of high electron temperatures and their corresponding effects on conductivity and power density in magnetohydrodynamic generators have been examined theoretically. For argon seeded with various small amounts of cesium, it was found that the presence of seed is actually deleterious to electron heating. The maximum electron temperature, conductivity, and power density are attained without seed. The effect of ion slip has also been analyzed, and the value of the ratio of magnetic field to gas pressure for maximum power density has been determined for unseeded argon. Author

N64-15252 General Electric Co., Philadelphia, Pa. Missile and Space Div.
FINITE RATE PLASMA GENERATION IN THE LAMINAR AIR BOUNDARY LAYER OF SLENDER REENTRY BODIES
F. G. Blottner and M. Lenard *In* AF Systems Command Trans. of the 8th Symp. on Ballistic Missile and Space Technol., Vol. 2 [1963] p 4–33 refs (See N64-15251 07-01)

Calculations are performed for the electron densities in the plasma sheath surrounding a slender reentry vehicle. The computations depend on the accurate description of the inviscid shock layer surrounding the vehicle and the chemical equilibrium caused by the rate of ionization, since most of the energy is imparted to the air by the shock and pressure forces rather than by surface friction or shear forces (the case for blunt reentry bodies). In the case of a small tipped, slender-shape vehicle, the energy is imparted to the air by means of surface friction; consequently, the boundary layer will be a significant source of high-temperature air. A.L.B.

N64-15254 Lockheed Aircraft Co., Sunnyvale, Calif.
CHEBYSHEV METHOD FOR THE CALCULATION OF RADAR CROSS SECTION OF PLASMA WAKES
K. Fong *In* AF Systems Command Trans. of the 8th Symp. on Ballistic Missile and Space Technol., Vol. 2 [1963] p 65–81 refs (See N64-15251 07-01)
(Contract NOw 63-0050-c)

This paper presents the Chebyshev method by which the field equation of a radially varying plasma wake is numerically solved. Using the computed values, along with values for the Bessel and Hankel functions, the radar cross section of the cylindrical wake can be computed. The advantage of this method, against the use of power series, is that strong convergence is assured due to the use of Chebyshev series. Author

N64-15255 Aerospace Corp., El Segundo, Calif. Laboratories Div.
ANALYSIS OF ELECTROMAGNETIC WAVE PROPAGATION THROUGH RE-ENTRY INDUCED PLASMA SHEATHS
Richard R. Gold *In* AF Systems Command Trans. of the 8th Symp. on Ballistic Missile and Space Technol., Vol. 2 [1963] p 83–96 refs (See N64-15251 07-01)
(Contract AF 04(695)-169)

An exact solution is obtained to the general problem of propagation of plane harmonic electromagnetic waves across a stratified plasma layer. The variation of the plasma properties in the direction normal to the layer is arbitrary, and oblique incidence is considered with no applied magnetic field. A constant magnetic field applied normal to the layer is included for the case of normal incidence. The solution is based on an integral equation formulation of the problem and is expressed as an infinite series. It is particularly useful when the ratio of slab thickness to free space wavelength (L/λ_0) is small. The resultant, relatively simple algebraic expressions for the reflection and transmission coefficients give an excellent approximation in many applications of current interest. Author

N64-15256 Aerospace Corp., El Segundo, Calif. Laboratories Div.
INTERACTION OF HIGH-POWER MICROWAVES WITH A REENTRY VEHICLE PLASMA SHEATH
Melvin Epstein *In* AF Systems Command Trans. of the 8th Symp. on Ballistic Missile and Space Technol., Vol. 2 [1963] p 97–119 refs (See N64-15251 07-01)
(Contract AF 04(695)-169)

An exact solution has been derived for the propagation of electromagnetic waves through an inhomogeneous plasma slab. Although the solution is expressed in terms of an infinite series, an accurate approximation is obtained using just the first two terms, provided that the slab is sufficiently thin. This result is used in developing an approximate analysis of the interaction between a strong electromagnetic wave and a thin plasma sheath. The results of the analysis indicate that even at power levels below breakdown, the absorption of electromagnetic energy by the plasma may significantly alter the propagation characteristics of the plasma. Further, the presence of plasma in the irradiated region is found to markedly affect the character of the breakdown process. Small amounts of plasma are found to eliminate breakdown in the usual sense. The electron density increases rapidly, but continuously, as the incident power is increased. Author

N64-15356 Princeton U., N.J. Plasma Physics Lab.
ION DENSITY MEASUREMENT IN A BARIUM PLASMA BY SCATTERING OF RESONANCE RADIATION
F. W. Hofmann Oct. 1963 20 p
(Contract AT(30-1)-1238)
(MATT-207)

A method for measuring local atom or ion densities, based on the scattering of resonance line radiation, is discussed for the case of an optically thin barium plasma confined by a strong magnetic field. The anisotropy of the flux of scattered resonance radiation due to anisotropic illumination and the presence of a magnetic field is examined. Barium ion-density measurements on a laboratory plasma are described. It is noteworthy that this method is capable of high spatial resolution, and that light-intensity ratio measurements suffice to obtain absolute ion densities. Author

N64-15360 RAND Corp., Santa Monica, Calif.
MAGNETOHYDRODYNAMIC-HYPERSONIC VISCOUS FLOW NEAR THE STAGNATION POINT OF A BLUNT BODY
M. C. Smith and C. S. Wu Jan. 1964 15 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-3970-PR; AD-429352)

The equations governing the hypersonic flow about a magnetized body are solved numerically. The solutions obtained illustrate the effects of Reynolds number and magnetic parameter on the structure of the applied magnetic field. The results show that for magnetic parameters larger than a critical value, numerical solutions do not exist. A critical magnetic parameter is considered to result from an assumption of a given magnetic field at the shock. By increasing the conductivity, and thereby the induced magnetic field, the applied field at the shock disappears. This, in turn, violates the basic assumption of a finite field at the shock. It is concluded that the applied magnetic field can only be defined at the body, where it is a natural characteristic of the problem. Author

N64-15368 California U., Berkeley Electronics Research Lab.
ON THE QUASI-STATIC ANALYSIS OF WAVES IN A PLASMA-FILLED WAVEGUIDE
J. E. Scharer (M.S. Thesis) and A. W. Trivelpiece 25 Nov. 1963 30 p refs
(Contract AF 19(628)-324; Grant AF-AFOSR-139-63)
(AD-428783)

The problem of determining the dispersion relations, electromagnetic field, and power flow in a cylindrical plasma-filled guide with a finite, axial magnetic field is discussed. The quasi-static analysis used and the conditions for its validity are presented. The hybrid structure (coupled TE and TM modes with two eigenvalues) of the fields that is present in the exact analysis is brought out from an extension of the quasi-static analysis. It is shown that under certain conditions the dispersion relation and electromagnetic field derived from the quasi-static analysis agree with the exact solution, even though the phase velocities for the wave modes are greater than the velocity of light. Author

N64-15493 Northeastern U., Boston, Mass.
STUDIES ON PLASMAS AND PULSED MAGNETIC FIELD EFFECTS
G. Lanza, J. Babakian, J. Davis, T. J. Morin, Jr., and G. R. Peacock *In its* Res. in Energy Conversion 22 Nov. 1963 p 260–284 refs (See N64-15489 07-01)

Two related aspects of magnetohydrodynamics were investigated: (1) Plasma thermocouples— a device, which operates on the plasma thermocouple principle, was developed for the conversion of thermal energy into electrical energy. To develop a theory for the operation of plasma thermocouples, the existing theory of conventional thermocouples was first reviewed and revised. Using the concepts of irreversible thermodynamics, the Seebeck, Peltier, and Thomson coefficients were obtained from the phenomenological equations. (2) Pulsed magnetic field effects—to generate pulsed magnetic fields, the Brechna modification of the Bitter helix was recommended, since it is capable of providing high fields over reasonable volumes. As for pulsed light sources, the RF type appeared to be the most suitable for the study of vapors.
R.T.K.

N64-15516 Yale U. Observatory, New Haven, Conn.
BREMSSTRAHLUNG CROSS SECTIONS IN THE NEIGHBORHOOD OF THE PLASMA FREQUENCY
Ludwig Oster Wright-Patterson AFB, Ohio, Aerospace Res. Labs., Nov. 1963 32 p refs
(Contract AF 33(657)-7271)
(ARL-63-209; AD-429408)

The spontaneous emission probability due to the bremsstrahlung mechanism for photons whose frequencies are close to the plasma frequency is computed on the basis of classical radiation theory. The particle orbits are calculated using for the interaction potential electron-ion a Coulomb form that is cut off at the Debye distance. The resulting emission probability undergoes a rapid, smooth transition at frequencies close to the plasma frequency from the logarithmic frequency dependence, typical of the high-frequency limit, to the frequency-independent expression, derived in the d.c. limit. It is shown that, for all practical purposes, shielding corrections can be neglected in computing the Fourier components of the acceleration, but must be applied for frequencies in the neighborhood of the plasma frequency, when the spectrum is averaged over collision parameters. Author

N64-15523 Avco-Everett Research Lab., Everett, Mass.
THERMAL CONDUCTIVITY OF ARGON AT HIGH TEMPERATURES
M. Camac and R. M. Feinberg Mar. 1963 53 p refs
(Contract AF 04(694)-33; Contract AF 49(638)-1129)
(Avco Everett Res. Rept.-168; BSD-TDR-63-250; AD-429757)

The infrared heat-transfer gage was used for end-wall measurements of the convective heat transfer from argon behind the reflected shock. The thermal conductivity of neutral (un-ionized) argon was measured before the ionization relaxation time, and could be fitted with the temperature dependence $T^{0.76 \pm 0.03}$ over the free-stream temperature range from 20,000° to 75,000° K, corresponding to incident shock velocities from 3 to 6 mm/μsec. At later times, after the free stream established equilibrium ionization, the convective heat-transfer rate remained the same as the initial neutral argon rate. Theoretical predictions of Fay and Kemp, assuming equilibrium boundary-layer conditions, are 20% to 30% below the experimental values. Also reported in this paper are measurements of the ionization times behind the reflected shock, and these are in agreement with an extrapolation of the Petschek and Byron measurements behind the incident shock. There is a discussion of the large changes in the gas conditions behind the reflected shock due to the ionization process. Author

N64-15584 Air Force Cambridge Research Labs., Bedford, Mass. Microwave Physics Lab.

NONLINEAR TRANSMISSION CHARACTERISTICS OF THE PLASMA SHEATH

Robert J. Papa May 1963 106 p refs

(AFCRL-63-133; AD-407089)

A model is constructed of a nonlinear, one-dimensional, inhomogeneous, multicomponent plasma slab which has the characteristics of the plasma sheath surrounding a typical hypersonic reentry vehicle at 200,000 ft while traveling at about 18,000 ft/sec. A plane wave incident upon the slab at arbitrary angle can induce changes in electron temperature without affecting the neutral gas temperature. The variations of electron temperature produce changes in collision frequency and the rate coefficients describing the various electron production and loss mechanisms. Such changes cause alterations in the effective dielectric constant of the medium. On the basis of a model of a plane-layered medium composed of a stack of linear homogeneous sheets, the reflection and transmission coefficients of the nonlinear slab may be computed by a step-by-step numerical integration of Maxwell's equations expressed in the form of difference equations. Author

N64-15749 General Applied Science Labs., Inc., Westbury, N.Y.

EFFECTS OF TRANSMITTED RADIATION PATTERNS ON THE RADAR RETURN FROM A PLASMA-CONTAINING HALF-SPACE UNDER OBLIQUE ILLUMINATION

Frank Lane and Sulmo Mariano 31 Dec. 1963 57 p refs

(Contract NOw63-0637-c(FBM))

(GASL-TR-372; AD-429860) OTS: $5.60

An investigation was conducted to assess the effects on backscattering from a simple plasma configuration of a class of incident electromagnetic wave patterns, which bear a close resemblance to actual radar field patterns. A half-space of uniform plasma was exposed to a linearly polarized incident field having a lobe pattern similar to patterns actually achieved and a variable parameter capable of sharpening up or broadening out this pattern. The axis of the main lobe was directed obliquely with respect to the interface separating the plasma and the free space. This question as to what sort of back scatter is observed for an obliquely incident wave with a more realistic pattern is answered in terms of the received signal and the ratio of the energy received to the energy output. The analysis is generalized to encompass any axisymmetric far-field pattern with the linear polarization. The result is a recipe that gives the signal received directly in terms of the transmitted field pattern. C.L.W.

N64-15751 Applied Physics Lab., Johns Hopkins U., Silver Spring, Md.

TASK R. A PROGRAM OF RESEARCH IN PHYSICOCHEMICAL AND FLUID DYNAMIC PHENOMENA BASIC TO THE UNDERSTANDING OF HIGH-TEMPERATURE, HIGH-SPEED GAS FLOW Quarterly Progress Report No. 19, 1 Oct.-31 Dec. 1963

N. De Haas et al [1963] 42 p refs

(Contract NOw-62-0604-c; ARPA Order 22-63)

(SR-4-3; AD-429855)

This report gives the final results of the first phase of a program to use ESR as a means to measure gas phase free-radical concentrations. O and N atoms in a flow tube were used for this test, with molecular oxygen providing an ESR calibrating substance. Titrations of O and N with NO_2 and NO, respectively, were employed to obtain independent measurements of concentrations, which were compared with the ESR values. In close association with the above measurements, the following two significant results were obtained: (1) The theoretical intensities of the various O_2 lines as given by Tinkham and Strandberg were shown to be internally consistent. (2) In the titration of N atoms with NO, where an O atom is generated for every reacted N, it was shown that the initial concentration of N is equal to the concentration of O at the titration point (N concentration is zero). These results verify the theoretical expressions used, and confirm the entire measurement procedure. Author

N64-15765 Polytechnic Inst. of Brooklyn, N.Y.

RADIATING LAMINAR BOUNDARY LAYER OF A GREY GAS OVER A FLAT PLATE

Pasquale M. Sforza Nov. 1963 29 p refs

(Contract Nonr 839(34))

(PIBAL-812; AD-430312)

An analysis of the nonsimilar laminar boundary-layer flow of a radiating gas over a flat plate is presented. It is assumed that the radiative properties are those for a grey gas and that no chemical reactions occur in the flow. An integral method is applied to the governing equations wherein the profiles of flow variables are chosen for their simplicity and their applicability to a two-layer approach. Four parameters are left free in the assumed profiles: one in the velocity profile, two in the temperature profile, and a scale parameter between the two profiles. Different envelopes of dynamical and energetic effects are recognized thereby. A system of first order, nonlinear, ordinary differential equations describing the chordwise variation of profile parameters is presented, and the solution to this system discussed. Author

N64-15805 University of Southern Calif., Los Angeles School of Engineering

RADIATION FROM AN AXIALLY SLOTTED CYLINDER WITH A RADIALLY INHOMOGENEOUS PLASMA COATING

W. V. T. Rusch Mar. 1963 37 p refs

(Contract AF 19(604)-6195)

(USCEC-82-210; EE-20; AFCRL-63-65; AD-404167)

The relative dielectric constant was assumed to have three types of radial dependence: monotonic with a minimum at the inner edge of the sheath but with no portion of the sheath below plasma resonance; monotonic with the inner portion of the sheath below plasma resonance; and parabolic with a minimum within the sheath and the inner portion of the sheath below resonance. The radial wave functions within the sheath are obtained in the form of infinite series. The resulting radiation patterns are found to be sharply directed in the forward direction relative to the equivalent free-space pattern. Author

N64-15812 Aerospace Corp., El Segundo, Calif. Plasma Research Lab.

THE RADIATION FIELD OF A MAGNETIC DIPOLE ANTENNA IN A CONICAL SHEATH

D. C. Pridmore-Brown 11 Dec. 1963 45 p refs
(Contract AF 04(695)-269)
(SSD-TDR-63-319; TDR-269(4280-10)-2; AD-430089)

The radiation pattern of a magnetic dipole antenna that is situated on the axis of a cone of finite conductivity, such as a conical plasma sheath, has been calculated. The analysis makes use of Green's functions in terms of which an integral equation is set up for the induced current distribution in the conical sheath. This integral equation is then solved by a perturbation technique that is based upon the assumption that the sheath is highly reflecting. The current distribution calculated in this way is used as a source to obtain the far-field radiation pattern. Author

N64-15906* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

SOME THEORETICAL BASES FOR SELECTION OF MOLECULAR ION PROPELLANTS AND A SURVEY OF MOLECULAR PLASMA COLLISION PROCESSES

John V. Dugan, Jr. Washington, NASA, Feb. 1964 46 p refs
(NASA TN D-1185) OTS: $1.25

The advantages of using heavy molecules as propellants for an electron-bombardment ion thrustor are recounted. Fragmentation of molecules under electron impact in the discharge chamber is a serious obstacle to the attainment of a heavy ion beam and is discussed theoretically. The nature of localized chemical bonding in diatomic molecules is explained in detail by use of the familiar potential-energy curves. Polyatomic molecules with their complex energy-state structure are discussed in an analogous manner, and their possible fates under electron impact are enumerated with respect to ionization and dissociation phenomena. Author

N64-15937 Cornell U., New York, N.Y.

THE ULTIMATE HYDROMAGNETIC FLOW PAST AN AIRFOIL FOR AN ALIGNED MAGNETIC FIELD Technical Report No. 6

G. S. Ludford and S. Leibovich Dec. 1963 21 p refs
(Contract Nonr-401(46); NSF Grant G-19911)
(AD-429930)

This report is concerned with the setting up, from a resting state, of the steady flow of perfectly conducting inviscid liquid past a thin symmetric nonconducting and nonmagnetic airfoil in the presence of an aligned magnetic field. In the flow solution presented, conditions at infinity are ultimately disturbed. Within the strip bounded by lines parallel to the applied magnetic field, which circumscribe the airfoil, the fluid comes to rest relative to the airfoil; outside, it is undisturbed. The solution shows the complete development of the flow after an impulsive start, in particular, the Alfvén waves that travel out from the airfoil along the strip and bring the fluid to rest are shown. These waves carry the main disturbance, which is of order one compared to the thickness ratio of the airfoil. I.v.L.

N64-15939 Avco-Everett Research Lab., Everett, Mass.

SHOCK FRONT STRUCTURE IN O_2 AT HIGH MACH NUMBERS

Kurt L. Wray and Thomas S. Freeman Nov. 1963 23 p refs
(Contract DA-19-020-ORD-5476; Proj. Defender)
(Avco-Everett Res. Rept.-169; AD-429207)

Shock structure measurements were made on O_2 in a 24-in.-diam shock tube at initial pressures of 15μ and 30μ of Hg from Mach 4 to 21. An ultraviolet absorption technique using 1,470A radiation was employed to monitor the density of O_2 molecules. In order to reduce shock-front curvature effects, the knife-edge technique was employed using only a 4-in. optical path between knife edges. The data indicate that translational and rotational degrees of freedom are excited simultaneously. At about Mach 10, vibrational excitation begins to appear in the same zone as translational and rotational excitation; by Mach 14, all these processes occur simultaneously. Around Mach 16, dissociation starts to occur in the same zone. The thickness of the shock front decreases from three ambient mean free paths at Mach 4 to two ambient mean free paths at Mach 10 and remains essentially constant at higher Mach numbers. Author

N64-15950 Massachusetts Inst. of Tech., Cambridge Fluid Mechanics Lab.

STAGNATION POINT HEATING IN IONIZED MONATOMIC GASES

James P. Reilly Jan. 1964 27 p refs
(AF-AFOSR Grant 62-329)
(MIT. Fluid Mech. Lab. 64-1; AFOSR-5442; AD-430031)

This paper reports on measurements made of the heat transfer to the stagnation point of a cylinder in partially ionized monatomic gases, and assesses the effect of free electrons on the total gas thermal conductivity. Shock-heated argon and xenon were used as the test media, thus bypassing the dissociation phase present in diatomic gas heat transfer, and passing directly from the ideal gas to the ionized gas. Comparison of the experimental data is made with two real-gas estimates, the first including the effects of ionization only on the thermodynamic properties involved, and a second including the effects of ionization on both the thermodynamic and transport properties. The experimental results are in substantial agreement with the latter prediction where equilibrium is attained, and confirms the prediction of an increased gas thermal conductivity due to the presence of free electrons. Author

N64-15959 General Electric Co., King of Prussia, Pa. Missile and Space Div.

STUDY OF HYPERSONIC CONTAMINATED WAKE BY AN EXACT NUMERICAL SOLUTION

Huon Li Dec. 1963 32 p refs
(Contract DA-30-069-ORD-1955)
(R63SD68; AD-429309)

A theoretical study of hypersonic wake with and without contaminants is presented. The nonlinear coupling equations of gas dynamics and chemical kinetics have been solved numerically by a finite-difference scheme. Typical calculations of laminar and turbulent nonequilibrium wake are shown for a slender body with $\sqrt{C_D A}$ approximately equal to 10 cm. The results indicate that the air system and the air-plus-sodium system are in nonequilibrium at the altitude of 100,000 ft. This nonequilibrium characteristic may exist at even lower altitudes. The effects of sodium on the electron concentration are important. Since the de-ionization processes of sodium are relatively slow, the sodium-contaminated wake has a longer electron trail. Author

N64-15982 Nagoya U. (Japan) Inst. of Plasma Physics

UNIFIED THEORY OF RELAXATIONS IN PLASMAS

Taro Kihara and Osamu Aono Dec. 1963 75 p refs Submitted for publication
(IPPJ-17)

The Coulomb interaction in a plasma must be considered both from the point of view of binary collisions and from the point of view of collective interactions. In collision theory, on

the basis of binary collisions, and in wave theory, on the basis of collective interactions, divergent integrals must be cut off; hence, the numerical factors in the arguments of Coulomb logarithms remain undetermined. These two complementary theories have been unified in this report into a divergence-free theory. The results give exact arguments of the Coulomb logarithms. Author

N64-16038 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
PLASMA ELLIPSOID IN ITS OWN FORCE FIELD
A. Ya. Voronov 30 Oct. 1962 13 p refs Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. III, Fiz.-Astron. (Moscow), no. 5, 1960 p 74–80
(FTD-TT-61-67/1+2; AD-266753)

The conditions of equilibrium and stability of a charged spatially restricted plasma are examined. Author

N64-16045 RAND Corp., Santa Monica, Calif.
THE SCATTERING OF ELECTROMAGNETIC WAVES FROM PLASMA CYLINDERS: PART I
Phyllis Greifinger Aug. 1963 40 p refs
(ARPA Order 189-61; ARPA-SD-79)
(RM-3573-ARPA; AD-427062)

This memorandum reviews the theory of the scattering of electromagnetic radiation in the transverse magnetic mode by infinite plasma cylinders with radially varying electron-density distributions. Techniques for calculating the scattering cross section are described, with special emphasis placed on short wavelength scattering. Specific calculations of the back-scattering (radar) cross section are made in the geometrical-optics limit and in the Born-approximation limit for several monotonically decreasing electron-density distributions which have zero slope on the cylinder axis. The radar cross section in the region of transition from underdense to overdense plasma is programed and computed on the IBM 7090 for a Gaussian and for a quadratic electron distribution for wavelengths equal to 1/10 and 1/100 of the cylinder radius. Author

N64-16063 McDonnell Aircraft Corp., St. Louis, Mo.
INVESTIGATION OF MAGNETOHYDRODYNAMIC WAVES. VOLUME I: SUMMARY Final Report
C. D. Joerger 30 Nov. 1963 43 p
(Contract AF 19(628)-239)
(Rept. A219, Vol. 1; AFCRL-63-782, Vol. 1; AD-429152)

Conclusions, recommendations, and a summary of results are presented for a program carried out to investigate the pertinent factors influencing the creation, propagation, and detection of Alfvén waves in a partially ionized, low-density medium. An outline is also presented of the theoretical work performed in support of the experiments. P.V.E.

N64-16064 McDonnell Aircraft Corp., St. Louis, Mo.
INVESTIGATION OF MAGNETOHYDRODYNAMIC WAVES. VOLUME II: THEORY Final Report
C. D. Joerger 30 Nov. 1963 193 p refs
(Contract AF 19(628)-239)
(Rept. A219, Vol. 2; AFCRL-63-782, Vol. 2; AD-429153)

A discussion is presented of theoretical studies conducted in an attempt to describe plasma wave propagation in the ionosphere and in a laboratory-generated plasma environment. The theory of plasma waves based upon a three-fluid description (neutral, ion, and electron gases) is discussed. A general dispersion equation was derived, and then specialized, to enumerate the properties of transverse and longitudinal waves propagating along and across magnetic field lines. Special solutions of the equation were used to describe propagation in a plasma waveguide and to enumerate the existence criteria for Alfvén waves in the ionosphere, a hypervelocity impulse tunnel (HIT), and a plasma waveguide. The characteristics of the ionosphere are related to the characteristics of the ionized flow existing in the initial phases of the HIT flow. The properties of two small plasma facilities, an electromagnetic shock tube and an arc discharge tube, are described. P.V.E.

N64-16065 McDonnell Aircraft Corp., St. Louis, Mo.
INVESTIGATION OF MAGNETOHYDRODYNAMIC WAVES. VOLUME III: EXPERIMENTS Final Report
C. D. Joerger 30 Nov. 1963 197 p refs
(Contract AF 19(628)-239)
(Rept. A219, Vol. 3; AFCRL-63-782, Vol. 3; AD-429154)

The following experiments dealing with the propagation and detection of Alfvén waves are discussed: (1) Alfvén plane-wave experimentation in a hypervelocity impulse tunnel, (2) Alfvén-wave experimentation in a shock tube, (3) Alfvén-wave experiments in an arc discharge tube, and (4) torsional Alfvén-wave experimentation in a hypervelocity impulse tunnel. P.V.E.

25 PHYSICS, SOLID-STATE

Includes semiconductor theory; and masers. *For related information see*: 09 Electronics; 23 Physics, General; and 24 Physics, Plasma.

N64-15013 Massachusetts Inst. of Tech., Cambridge Lab. for Insulation Research
GROWTH OF CRYSTALS BY FLAME FUSION
A. Linz, E. F. Farrell, M. J. Redman, A. Berkebile, and A. Vetrovs *In its* Mol. Orbitals and Electron-Transfer Spectra in Rutile Dec. 1963 26 p refs (See N64-15011 07-01)
(Contract AF 33(616)-8353; Contract AF 19(628)-395)
(MIT-TR-185)

This report covers the application of the flame-fusion technique to the growth of various types of oxide crystals. Details of the design of a three-tube coaxial postmix oxyhydrogen torch with an efficient powder-feed mechanism are given, as well as feed preparation methods and growth conditions for a number of crystals, including Al_2O_3 (corundum), (Al, $Cr)_2O_3$ (ruby), Cr_2O_3, Y_2O_3, TiO_2, $SrTiO_3$, MnO, NiO, CoO, and (Ni,Co)O. The advantages and disadvantages of the flame-fusion method for various types of materials are discussed with relation to alternate methods. Author

N64-15014 Joint Publications Research Service, Washington, D.C.
SOVIET STUDIES ON DISLOCATION STRUCTURES
30 Jan. 1964 44 p refs Transl. from Russian into ENGLISH of 5 articles
(JPRS-22981; OTS-64-21430) OTS: $1.25

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2. EFFECT OF DISLOCATIONS ON GRAIN STRUCTURE OF INDIUM FUSED IN GERMANIUM U. Ertelis p 11–14 refs (See N64-15016 07-25)

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4. SUZUKI ATMOSPHERES IN BRASSES AND ALUMINUM BRONZES V. Ye. Panin, Ye. F. Dudarev, and M. A. Bol'shanina p 25–33 refs (See N64-15018 07-25)

5. THE SOLUTION OF CERTAIN KINETIC EQUATIONS IN THE THEORY OF DISLOCATION B. Ya. Lyubov p 34–41 refs (See N64-15019 07-25)

N64-15015 Joint Publications Research Service, Washington, D.C.

STATISTICAL THEORY OF AKULOV'S DISLOCATIONS

P. P. Galenko and V. A. Franyuk *In its* Soviet Studies on Dislocation Struct. 30 Jan. 1964 p 1–10 refs Transl. into ENGLISH from Fiz. Metal. i Metalloved. (Sverdlovsk), v. 15, no. 5, May 1963 p 773–778 (See N64-15014 07-25) OTS: $1.25

A rebuttal is presented to a critical review of a book by N. S. Akulov, entitled "Dislocations and Plasticity." P.V.E.

N64-15016 Joint Publications Research Service, Washington, D.C.

EFFECT OF DISLOCATIONS ON GRAIN STRUCTURE OF INDIUM FUSED IN GERMANIUM

U. Ertelis *In its* Soviet Studies on Dislocation Struct. 30 Jan. 1964 p 11–14 refs Transl. into ENGLISH from Latvijas PSR Zinatnu Akad. Vestis (Riga), no. 8, (193), 1963 p 53–56 (See N64-15014 07-25) OTS: $1.25

An investigation into the form of the front, which occurs when indium is fused onto germanium, as a function of the density of dislocations introduced in the germanium as a result of plastic deformation, led to the following conclusions: (1) The regularity of the front of fusion in the (111) plane was decreased as the density of dislocations was increased. (2) The sloping part of the fusion front became steeper with an increase in the density of dislocations. (3) The diameter of the melted zone was greater in the region with a low density of dislocations. P.V.E.

N64-15017 Joint Publications Research Service, Washington, D.C.

SPONTANEOUS SHIFTING OF DISLOCATIONS IN SINGLE CRYSTALS OF LIF

V. B. Pariyskiy, A. I. Landau, and V. M. Borzhkovskaya *In its* Soviet Studies on Dislocation Struct. 30 Jan. 1964 p 15–24 refs Transl. into ENGLISH from Fiz. Tverd. Tela (Leningrad), v. 5, no. 9, Sep. 1963 p 2570–2575 (See N64-15014 07-25) OTS: $1.25

The phenomena of a spontaneous step-like motion of dislocations in single crystals of LiF, which are not subjected to any external influences at the time of such motion, were investigated. It is shown that, on the basis of statistical processing of experimental data, the motion is actually of a step-like nature and is connected with moving dislocations overcoming local stops. The experimental dependence of the average length of a spontaneous shift in a dislocation on the relaxation time of a single crystal was obtained. It is also shown that the spontaneous step-like motion of the dislocations in single crystals of LiF is caused by the same stops that cause the step-like motion of dislocations when the surface of a crystal is etched. The average time a dislocation remained between two successive shifts (15 to 30 minutes) was estimated on the basis of the experimental data that were obtained. P.V.E.

N64-15018 Joint Publications Research Service, Washington, D.C.

SUZUKI ATMOSPHERES IN BRASSES AND ALUMINUM BRONZES

V. Ye. Panin, Ye. F. Dudarev, and M. A. Bol'shanina *In its* Soviet Studies on Dislocation Struct. 30 Jan. 1964 p 25–33 refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 152, no. 1, Sep. 1963 p 92–95 (See N64-15014 07-25) OTS: $1.25

Calculations are presented for determining the concentration dependence of Suzuki atmospheres and their contribution to hardening of an alloy, taking into account the dependence of the energy of packing defects on the concentration of the alloy $\gamma = \gamma(c_0)$. The solid solutions Cu-Zn and Cu-Al, for which the experimental relationships $\gamma = \gamma(c_0)$ are known, are considered. The calculations show that the role of Suzuki atmospheres decreases with a group of c_0 in concentrated Cu-Zn and Cu-Al solid solutions. It is concluded that experimental curves $\gamma = \gamma(C_0)$ are essential for calculating Suzuki atmospheres and their contribution to hardening. Suzuki atmospheres make large contributions to hardening in those alloys (and in those regions of concentrations) where there is a strong concentration dependence $\gamma = \gamma(C_0)$. P.V.E.

N64-15019 Joint Publications Research Service, Washington, D.C.

THE SOLUTION OF CERTAIN KINETIC EQUATIONS IN THE THEORY OF DISLOCATION

B. Ya. Lyubov *In its* Soviet Studies on Dislocation Struct. 30 Jan. 1964 p 34–41 refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 152, no. 5, Oct. 1963 p 1092–1095 (See N64-15014 07-25) OTS: $1.25

Equations are developed that allow the use of kinetic equations in solving the problem of the equilibrium positions of dislocations in metals under loads. For the example, the results can be utilized in analyzing the development, in time, of plastic deformation caused by dislocations originally located close to the origin of the coordinate system $x=0$. P.V.E.

N64-15094 Althea Revere, Vineyard Haven, Mass.

ELECTRON MICROSCOPE STUDIES OF THE SURFACE STRUCTURE OF WHISKERS GROWN FROM IRON CHLORIDE

B. K. Morse Wright-Patterson AFB, Ohio, AF Materials Lab., Nov. 1963 37 p

(Contract AF 33(657)-8554)

(ASD-TDR-63-4136; AD-429183)

Whisker specimens have been produced under new types of growth conditions with ultra-pure ferrous chloride containing small amounts of cobaltous chloride at 700°C. Although individual whiskers within each specimen boat may vary somewhat, their surface topography appears to follow definite patterns. In most specimens, regardless of growth conditions, these typical patterns show variation in surface structure from the base to the tip areas. Detail in surface contours appears to be more uniform in whiskers that develop well-formed tips. When whiskers grown with the addition of cobaltous chloride could be broken, their fractured cross-section surfaces exhibited a shell and core structure similar to that found in whiskers that were previously studied in this program. A number of the fractured specimens had fine exterior surface detail, which has not been seen in earlier whiskers. Author

N64-15113 Naval Ordnance Lab., Corona, Calif.

SOLID STATE SPECTROSCOPY OF RARE EARTH IONS

R. A. Buchanan, J. Murphy, and H. H. Caspers In ONR Solution to Navy Probl. through Advanced Technol. [1963] p 175–188 refs (See N64-15101 07-01) OTS: $5.00

The rare-earth elements (type 4f) are those members of the periodic table with atomic numbers 57 through 71. The 4f electronic energy levels discussed are found in the trivalent rare earths. The topics discussed are crystalline field effects, charge compensation, and the spectra of Ce^{3+} R.T.K.

N64-15115 Naval Ordnance Lab., Corona, Calif.
PROPERTIES AND DEVICE APPLICATIONS OF EVAPORATED InSb FILMS
H. H. Wieder In ONR Solution to Navy Probl. through Advanced Technol. [1963] p 206–226 refs (See N64-15101 07-01) OTS: $5.00

The galvanomagnetic properties of evaporated intermetallic semiconductor films of indium antimonide are investigated and are presented with emphasis on their application to devices employing the Hall effect. The design and construction of a magnetometer based on the pulsed operation of a thin-film Hall generator are described in detail. The magnetometer is capable of resolving d.c. or alternating magnetic fields of the order of 10^{-4} gauss. Operation of either d.c.- or pulse-driven analog multipliers, dividers, square root computers, and function generators based on the Hall effect in InSb films are discussed and compared to similar devices using bulk crystalline materials. Author

N64-15116 Naval Ordnance Lab., White Oak, Md.
EPITAXY OF PbS, PbTe, AND SnTe
Jay N. Zemel In ONR Solution to Navy Probl. through Advanced Technol. [1963] p 227–245 refs (See N64-15101 07-01) OTS: $5.00

The main purpose in studying PbS, PbTe and SnTe was to discover the band structure and fundamental processes occurring in these materials. Particular stress was placed on producing high-quality bulk single crystals. The photoconductivity of films of polycrystalline PbS and the mobility of holes in these p-type films were investigated. Since mobility was not dependent on the carrier concentration for a set of films having the same thickness, it was decided to investigate this phenomenon at greater length using thin single crystals. The results of the investigation indicate good, thin, single crystals of the lead salts can be prepared; many fundamental processes can be advantageously studied using these films; and because of the relative simplicity in their preparation, these materials show promise for device application. R.T.K.

N64-15117 Naval Research Lab., Washington, D.C.
IN-PILE HALL ELECTRON TRANSPORT PROPERTY MEASUREMENTS ON ZONE-REFINED, P-TYPE SILICON
G. C. Bailey and C. M. Williams In ONR Solution to Navy Probl. through Advanced Technol. [1963] p 246–262 refs (See N64-15101 07-01) OTS: $5.00

The experiments discussed represent the first measurements of the Hall coefficient of silicon to be made in-pile, i.e., during neutron irradiation. In contrast to most of the previous investigations that were carried out on pulled silicon having about 10^{18} oxygen atoms/cm^3, the present experiments were made on zone-refined silicon containing less than 10^{16} oxygen atoms/cm^3. R.T.K.

N64-15150 Atomics International, Canoga Park, Calif.
RAPID OXYGEN DIFFUSION IN BERYLLIUM OXIDE
S. B. Austerman and R. A. Meyer 30 Nov. 1962 16 p refs (Contract AT(11-1)-GEN-8)
(NAA-SR-7637) OTS: $0.50

Previous data on oxygen diffusion in polycrystalline BeO showed two separable regions of diffusion kinetics, and also indicated a third region of very deep, but low-magnitude, penetration by diffusant O^{18}. This deep penetration is verified and is regarded as being due to a rapid diffusion process. In addition, there appears to be a slight, but detectable, intrusion of H_2O^{18} vapor into grain boundaries at a particular stage of sample preparation. Author

N64-15298 Aerospace Corp., El Segundo, Calif. Electronics Research Lab.
ELECTRONICS RESEARCH PROGRAM: INVESTIGATION OF ELECTRONIC PROPERTIES OF THIN FILMS Semiannual Technical Note, 1 Jan.–30 Jun. 1963
F. L. Vernon, R. J. Pedersen, and J. Crumley 25 Nov. 1963 26 p refs
(Contract AF 04(695)-169)
(SSD-TDR-63-316; TDR-169(3250-12)TN-2; AD-427898)

The effects of a variety of parameters on the formation of metallic stearate films are discussed. Substrate cleaning techniques and the role of the spreading solvent are emphasized. In addition, a new method for the deposition of the initial organic monolayer is described; in many respects this method has proven superior to the original Langmuir–Blodgett technique. Reliable metal-oxide tunneling junctions on the end of thin quartz rods have been fabricated for configurations of the type Al-Al_2O_3-M_x (where M_x is usually a soft superconductor, such as Pb or Sn). A new evaporator is described, which will provide considerable flexibility in the fabrication of thin film electronic devices. Author

N64-15300* Massachusetts Inst. of Tech., Cambridge
MEDICAL PROGRESS. OPTICAL MASERS IN BIOLOGY AND MEDICINE
Ronald A. Malt, and Charles H. Townes Repr. from New Engl. J. Med., v. 269, 26 Dec. 1963 p 1417–1421 refs
(NASA Grant NsG-330)

The optical maser has broad applicability in biology and medicine because it makes available, for the first time, stable, highly directive, conveniently handled, coherent optical radiation of truly enormous intensity. As a consequence, light beams with equivalent temperatures of 10^{20}° K are available in rays capable of being concentrated within a diameter of 1 micron; new electromagnetic effects of intense light become significant; signals may be sent long distances on modulated optical beams; and interference effects may be noted over path differences of thousands of kilometers rather than of a few meters. The uses of lasers and masers as a heating source, in spectroscopy and photography, and in long-range monitoring are discussed. R.T.K.

N64-15361 Microwave Associates, Inc., Burlington, Mass.
LONG LIFE K-BAND DUPLEXER Fifth Quarterly Technical Report, 1 Jul.–1 Oct. 1963
P. Basken and R. Brunton Oct. 1963 47 p
(Contract DA-36-039-SC-90834)
(AD-428787)

The gaseous TR tube development was directed toward design refinements on new tubes based on the test performance secured to date. New designs have been envolved, and tests on overall performance and life test data are reported. Data taken with varactor diodes in the circuits previously developed are reported in detail. Data are also reported on tests where the gas TR tube and a semiconductor limiter combination were subjected to high power. Leakage power and crystal protection data taken in tests on this configuration are reported. Author

N64-15365 Ohio State U. Research Foundation, Columbus Antenna Lab.
SOME EXPERIMENTAL MEASUREMENTS OF THE CHARACTERISTICS OF Q-SWITCHED LASERS
Raymond E. Whitacre 15 Nov. 1963 52 p refs
(Contract AF 33(657)-10824)
(BPSN-3630-5237; Rept. 1579-5; AD-429006)

Measurements of the variation in peak power output from a Kerr cell, Q-switched ruby laser and a rotating-roof prism, Q-switched ruby laser as a function of the parameters of the laser systems are reported. Emphasis is placed on optimizing the power output from the Kerr cell system by considering the effects of variations in pumping energy, output end reflectivity, delay time between flashlamp firing and Q-switching, reflector alignment, and cavity length. A detailed description of the physical arrangement and the operation of the two systems is presented. Author

N64-15371 Ohio State U. Research Foundation, Columbus, Antenna Lab.
MICROWAVE THEORY AND THE BREAKDOWN OF GASES BY RUBY LASER RADIATION
Richard G. Tomlinson 31 Dec. 1963 24 p refs
(Contract AF 33(657)-10824)
(Rept. 1579-7; AD-428865)

Microwave breakdown theory is extrapolated to the 6943 A, ruby laser wavelength. The need for a breakdown criterion other than that for the critical plasma frequency, sometimes used in microwave breakdown, is shown. A suitable criterion is developed from the solution of the electron-density continuity equation, including recombination loss. A solution for the breakdown electric field strength, or power density, for the pulse ruby laser in air as a function of pressure is obtained. The effect of varying pulse duration, initial electron density, and characteristic diffusion length is shown. A minimum power density of 10^{12} w/cm^2 is predicted for the breakdown of air by ruby laser radiation. Author

N64-15395 United Kingdom Atomic Energy Authority, Harwell (Gt. Brit.) Atomic Energy Research Establishment
FARADAY EFFECT IN SEMICONDUCTORS
I. M. Boswarva 1963 144 p refs
(AERE-R-4341) HMSO: 18/-NET

This thesis reviews the general macroscopic and quantum mechanical formula necessary to calculate the Faraday rotation in semiconductors. Dispersion relations between Faraday rotation and absorption coefficient are derived, and it is shown how these rotations can be used to introduce damping phenomenologically. The general formulas are then applied to calculate Faraday rotation caused by (1) allowed direct band-to-band transitions, (2) forbidden direct transitions, and (3) indirect phonon-assisted transitions between a pair of simple bands. The major part of the thesis is devoted to an analysis of the Faraday rotation due to direct allowed transitions near $\underline{k} = 0$ in semiconductors whose valence-band structure can be represented by the Luttinger–Kohn model. Specific computations have been performed to find the interband Faraday rotation in Ge, GaAs, InSb, InAs, and GaSb using effective mass parameters and other band constants. Author

N64-15465 Centre National d'Etudes des Telecommunications (France)
LASERS AND SEMICONDUCTORS [LASERS ET SEMICONDUCTEURS]
M. G. A. Bernard and G. Duraffourg *In* AGARD, Paris Light and Heat Sensing 1963 p 185–191 refs In FRENCH (See N64-15452 07-23)

The possibility of obtaining, in semiconductors, the emissions stimulated by the transitions between the conduction bands and the valence bands, between one of these bands and an impurity level of the interdictive band, or by annihilation excitation is discussed. If the state of occupation of these bands and the levels are characterized by the pseudolevels of Fermi, the condition necessary for a stimulated emission is $\Delta F > h\nu$ where ΔF is the difference between the pseudolevels of Fermi of the initial state and the final state of the transition, and $h\nu$ is the energy of the induced photon. The direct transitions from band to band in InAs and InSb and the transitions between the bands of conduction and the acceptor levels of Zn and In, respectively, in Ge and Si are presented. An analysis is made of the various causes of loss, and the particular cases in which conditions for obtaining the laser effect can be realized are discussed. Transl. by I.v.L.

N64-15466 Massachusetts Inst. of Tech., Cambridge
CHARACTERISTICS OF A GASEOUS OPTICAL MASER
A. Javan *In* AGARD, Paris Light and Heat Sensing 1963 p 193–197 refs (See N64-15452 07-23)

This report is concerned with the basic operation and frequency characteristics of gaseous optical masers; the presently operating He–Ne maser is particularly emphasized. The use of this device as a standard of length and some of its spectroscopic applications are discussed. Author

N64-15467 Bell Telephone Labs., Inc., Murray Hill, N.J.
CONTINUOUSLY PUMPED SOLID STATE OPTICAL MASERS
W. S. Boyle and D. F. Nelson *In* AGARD, Paris Light and Heat Sensing 1963 p 199–206 refs (See N64-15452 07-23)

In this paper two specific devices, the chromium-doped aluminum oxide (ruby) and neodymium-doped calcium tungstate solid-state masers, are examined. A comparison is made between two different pumping geometries; the importance of the spectroscopic properties of maser crystals in determining the pumping requirements is illustrated. Author

N64-15469 Hughes Research Labs., Malibu, Calif.
LASERS FOR COMMUNICATIONS AND OPTICAL RANGING
George F. Smith *In* AGARD, Paris Light and Heat Sensing 1963 p 221–234 refs (See N64-15452 07-23)
(Contract AF 33(616)-8233)

The three key properties of the laser light source—brightness, focusability, and monochromaticity—enable it to transmit information efficiently to a distant point even in the presence of other undesired radiation "noise," because that noise can be rejected by a filter. In a one-way communications link with constant-aperture diffraction-limited antennas, the fraction of transmitted power that is received is proportional to the square of the frequency. Signal fluctuation noise, however, increases linearly with frequency, so the S/N ratio improves only linearly with frequency. At optical frequencies, aiming problems are likely to limit the useful degree of beam collimation; thus, on the basis of bandwidth per transmitted watt, a laser space-communications link will be competitive with, but not drastically superior to, a futuristic microwave space link. The high-power pulse performance of ruby lasers is promising for optical ranging. Although rudimentary ranging systems have operated only at several kilometers, it now appears feasible to range off the moon. Author

N64-15490 Northeastern U., Boston, Mass.
TECHNIQUES FOR FABRICATION OF LARGE, THIN, SILICON SINGLE CRYSTALS
W. B. Nowak, R. D. French, and E. C. Steeves *In its* Res. in Energy Conversion 22 Nov. 1963 p 1–30 refs (See N64-15489 07-01)

Apparatus was constructed for producing silicon films by vapor deposition and by vacuum evaporation in order to attempt the fabrication of large single-crystal films of silicon for solar cells (1 to 10 microns thick, about 60 cm^2 area). $SiCl_4$ in H_2 at one atmosphere pressure was used in the vapor deposition; work-accelerated electron-beam heating and a silicon carbide anode with a deep well were used in the vacuum evaporation at about 10^{-5} torr. Fabrication techniques under investigation are nonepitaxial and include whole-surface exposure to the silicon atoms, planar edge-growth in the solid state, planar crystallization, and planar zone melting. Substrate testing has shown: (1) BN may be suitable if the spalling can be eliminated. (2) Mo is unsuited because of rapid interaction. (3) Liquid Sn is unsuited for vapor deposition because of the rapid formation of $SnCl_2$. (4) Films of unknown composition form on liquid NaCl and fluid glass during vapor deposition, thus intercepting the silicon deposit. Author

N64-15491 Northeastern U., Boston, Mass.
PROPERTIES OF NITROGEN-SULFUR SYSTEMS
R. N. Wiener, S. M. Smith, and D. N. Mitra *In its* Res. in Energy Conversion 22 Nov. 1963 p 31-109 refs (See N64-15489 07-01)

The structure of the N_4S_4 molecule is described. Resistance measurements on $(NS)_x$, calorimetric studies of N_4S_4 and N_2S_2, and the vibration spectroscopy of N_4S_4 and N_2S_2 are discussed. R.T.K.

N64-15614 Army Signal Research and Development Lab., Fort Monmouth, N.J.
ON THE FEASIBILITY OF AN ETTINGSHAUSEN SEMICONDUCTOR LASER
H. Mette, E. Schiel, and C. Loscoe Jun. 1963 14 p refs
(USAELRDL-TR-2374; AD-413364)

This report theoretically investigates the possibility of achieving stimulated recombination radiation in a semiconductor by an alternate method to the injection diode. The results show that an excess concentration of recombination carriers sufficient to initiate laser action may be obtained in semiconductors by drift and deflection in a magnetic field (Ettingshausen effect). However, further data are required to calculate the exact size of the threshold value. Although the current densities required for operating the device appear of an order similar to those required for injection diodes, the pumping method is based entirely on bulk effects. Therefore, the device offers a number of practical advantages over junction devices, such as a larger emitting area and fast response time. The design of a possible Ettingshausen laser is discussed in detail, and problem areas for future work are listed. Author

N64-15708 Army Signal Research and Development Lab., Fort Monmouth, N.J.
ZEEMAN EFFECT IN GAS DISCHARGE LASERS
Rudolf G. Buser, Johann J. Kainz, and John J. Sullivan Jun. 1963 15 p refs
(USAELRDL-TR-2322A; AD-412799)

Recent measurements of the intensity of the emission of a gas discharge laser are discussed in terms of Zeeman effect. By application of magnetic fields, it seems possible to induce mode switching. Author

N64-15720 India. Dept. of Atomic Energy, Bombay
CRYSTALLOGRAPHIC STUDIES ON H [Sm EDTA] H_2O AND H[Er EDTA]
V. Amirthalingam 1963 6 p refs
(AEET/CD/16)

Preliminary X-ray powder and single-crystal data of one light and one heavy rare-earth EDTA complex are presented. H[Sm EDTA] H_2O crystallizes from water as tiny light-yellow prisms and belongs to the tetragonal system. The crystals develop prominent (001) and not so prominent (110), (120) faces. The unit cell dimensions are a = 11.59 A and c = 36.6 A, the number of molecules in a unit cell is Z = 12, and the density is 1.86 and 1.89 gm-cm^{-3} (calculated and measured, respectively); the crystals belong to the space group $I4_{1/a}$. H[Er EDTA] crystallizes from water as light-pink tabular prisms. The crystals belong to the monoclinic system and have prominent (001), (120) faces. The cell dimensions are a = 11.74 A, b = 5.96 A, c = 12.11 A, and $\beta = 100°30'$. The number of molecules in the cell is Z = 2, the density is 1.84 and 1.82 gm-cm^{-3} (measured and calculated, respectively), and the space group is Pn. P.V.E.

N64-15757 Syracuse U., N.Y.
SUBMILLIMETER MASER INVESTIGATIONS WITH RUBY Technical Report, 1 Jun. 1962-31 Dec. 1963
J. Hermance and G. Wessel [Dec. 1963] 44 p refs
(Contract Nonr-669(18))
(AD-429381)

A theoretical study backed by a number of experiments has been carried out to investigate the feasibility of generating submillimeter radiation in ruby at 0.035-cm wavelength (870 kmc) between the ^2E levels. To achieve this generation, two different methods have been explored and are briefly described. In the first method both ^2E levels of ruby are populated by providing pumping action between the ^4F and the $^4A_2$ states that require green pumping light of about 5,600 A. In the second method two ruby crystals are employed, the first one to generate the R_2 line, which is used to pump the second ruby. C.L.W.

N64-15785* Jet Propulsion Lab., California Inst. of Tech., Pasadena
THE POTENTIAL ENERGY CURVE OF THE LOWEST LYING TRIPLET SIGMA STATE OF LITHIUM HYDRIDE
Howard S. Taylor 15 Aug. 1963 16 p refs
(NASA Contract NAS7-100)
(NASA CR-53060; JPL-TR-32-493)

The potential energy curve of the lowest lying triplet sigma state of lithium hydride has been computed by a variational technique. Linear combinations of products of two center molecular orbitals were used to approximate the wave function. All linear and nonlinear parameters are minimized, and open shell techniques are utilized. The triplet state is shown to be of a repulsive nature. Author

N64-15884 Battelle Memorial Inst., Columbus, Ohio
ALLOYING BEHAVIOR OF THE REFRACTORY PLATINUM-GROUP METALS Sixth and Seventh Quarterly Report [1 Dec. 1962-31 May 1963]
P. S. Rudman 29 May 1963 14 p refs
(Contract Nonr-2547(00))

This report summarizes the results obtained to date in the ruthenium-based systems: Ru-Mo, Ru-W, and Ru-Ta. The obtained lattice-parameter data and the Vegard's law plots are plotted. The Vegard's law plots were obtained by combining equations (1) $a = x_A a_A + x_B a_B$, $c = x_A c_A + x_B c_B$ and (2) $c_{hcp} = 1.03\sqrt{2}\, a_{bcc}$, $a_{hpc} = 1.03\,(\sqrt{3}/2) a_{bcc}$. Except for the data points for the Ru-10Ta alloy, which are so out of line as to be suspect, the data are rather well accounted for by this simple extension of Vegard's law. This application of the law cannot be used to account for the lattice-parameter behavior in general in these platinum-group-metal hcp phases, because the hcp phases occur even when neither of the components

is hcp. The present success of this extension can possibly be traced to a dominant atomic-volume effect, and hence provides an interesting clue to help rationalize the general lattice-parameter and phase-stability problem in these hcp alloys. I.v.L.

N64-15917 India. Dept. of Atomic Energy, Bombay
DIFFUSION OF CHROMIUM IN NICKEL
S. P. Murarka, M. S. Anand, and R. P. Agarwala 1963 15 p refs
(AEET/CD/17)

Diffusion of chromium in pure nickel has been studied using radioactive tracer and residual activity technique. Diffusion coefficient (in units of cm^2/sec) in the temperature range of 600° to 900° C is given by $D_{Cr/Ni} = 0.03 \exp(-40,800/RT)$ and in the range of 350° to 600° C is given by $D_{Cr/Ni} = 5.45 \times 10^{-9} \exp(-13,700/RT)$. This bimodal diffusion behavior has been explained on the basis of solid solubility of chromium in nickel, which falls very rapidly from 1000° C downwards. The entropy of activation for high-temperature diffusion falls very well on the entropy versus activation energy curve for lattice diffusion in nickel. Author

N64-15936 Princeton U., N.J. Plastics Lab.
PIEZO-RESISTIVE CHARACTERISTICS OF SOME ORGANIC SEMICONDUCTING POLYMERS
A. W. Henry and C. Cappas 15 Apr. 1963 43 p refs
(Contract DA-31-124-ARO(D)-21; Contract ONR 356-375)
(Tech. Rept.-67A; AD-403361)

A series of highly conjugated polymers with semiconducting characteristics was examined to determine the piezo-resistive behavior. The resistivities ranging from 10^2 to 10^{11} ohm-cm at room temperature and at 1,840 atmospheres pressure decreased 100 fold, and for some polymers, 1,000 fold, as the pressure was increased to 35,000 atmospheres. Elimination of voids and particle-to-particle contact problems was obtained by the extreme pressures used, as evidenced by: (1) absence of hysteresis in the piezo-resistivity; and (2) low measured permeation rate to air. A correlation between the extrapolated activation energy for the polyacene quinone radical (PAQR) polymers and the number of fused rings in the aromatic portion of the polymer was obtained. An elemental polymeric semiconductor with high conductivity (i.e., p-type tellurium) had a decreasing thermoelectric power with increased pressure and a relatively constant activation energy, both due to the p-type TeO_2 impurity. Author

N64-15956 California U., Berkeley
Technical Report No. 8 (Final) of Research Investigations [15 Jun. 1958-30 Sep. 1962] [FATIGUE AND CORROSION PROCESSES IN METALS AND METAL OXIDE CRYSTALS]
I. Cornet Dec. 1963 13 p refs
(Contract Nonr-222(67))
(AD-429227)

Fatigue of ionic crystals has been studied primarily in magnesium oxide. Under cyclic stress, dislocations move irreversibly and multiply; slip bands form and grow, cracks nucleate and propagate, and failure occurs. The use of ionic crystals, such as MgO, is advantageous in such investigations, because they are optically transparent. Individual dislocation intersections with (100) surfaces may be observed with a standard microscope, using etchpit techniques. Slip, deformation, crack formation, and fracture in MgO crystals under cyclic stress are compared with corresponding processes in metals. Author

N64-15962 Nuklearni Institut Jozef Stefan, Ljubljana (Yugoslavia)
IMPURITY CONDUCTION
P. Gosar and D. Justin Oct. 1963 18 p refs Lectures delivered at the 10th Yugoslav Summer School of Phys., Hercegnovi, Yugoslavia, Sep. 1963
(NIJS-R-419)

A theory is presented that explains the impurity conduction in semiconductors that is a consequence of the hopping motion of electrons from the occupied to the adjacent unoccupied donor states. The theory is based on the temperature-dependent Green's functions formalism. P.V.E.

N64-15978 Lockheed Missiles and Space Co., Sunnyvale, Calif.
LASER TECHNOLOGY: AN ANNOTATED BIBLIOGRAPHY [JAN. 1962-FEB. 1963]
Helen B. Mc Cormick, comp. Feb. 1963 98 p refs
(SB-63-23; Rept. 5-73-63-6)

Advances in laser technology are reported against the background of comprehensive treatment of laser characteristics and action; new materials evidencing laser action; laser applications and problems; and the continuing research that is making such applications more practicable. Subject coverage is selective and representative rather than complete. The inclusion of recent bibliographies and evaluations (Section I: Bibliographies, and Section II: Laser Action and Applications) provides the reader the opportunity for more detailed background and perspective. Author

N64-16086 Aerospace Corp., El Segundo, Calif. Electronics Research Lab.
ELECTRONICS RESEARCH PROGRAM: INVESTIGATION OF GAS LASERS AND NONLINEAR OPTICAL EFFECTS Semiannual Technical Note, 1 Jan.-30 Jun. 1963
T. S. Hartwick, E. R. Peressini, R. C. Ward, and C. J. Buczek 21 Dec. 1963 39 p refs
(Contract AF 04(695)-169)
(SSD-TDR-63-351; TDR-169(3250-21)TN-2; AD-430129)

An analysis is given of frequency modulation of a gas laser by a time-varying axial magnetic field. Preliminary experimental results are reported. A helium-neon laser employing a d.c.-excited discharge between close-spaced parallel electrodes has yielded laser action at a wavelength of 1.15 μ. Analysis and experimental results show that the "gain-switching" technique will be very useful for the repeated, reliable production of short, high-power laser pulses needed in the study of nonlinear optical effects and in optical radar. Author

N64-16091 Air Force Cambridge Research Labs., Bedford, Mass.
INFRARED ABSORPTION OF Mg_2Sn SINGLE CRYSTALS
Herbert G. Lipson Nov. 1963 33 p refs
(AFCRL-63-534; AD-430766)

Infrared transmission and reflection measurements of n- and p-type semiconducting Mg_2Sn single crystals of different impurity concentrations were made between 2μ and 30μ at temperatures ranging from 18° to 296° K. At incident photon energies less than 0.22 ev, strong free-carrier absorption is present whose dependence on wavelength λ can be approximated by a relation $\alpha = a + b\lambda^2$, where α is the absorption coefficient and a and b are constants. The absorption spectra due to other mechanisms have been analyzed after subtraction of the λ^2 free-carrier dependence. At energies of 0.22 ev and above, the rapid increase in absorption is attributed to the intrinsic edge. From the energy dependence of absorption in the edge region, the mechanism of indirect transitions between the valence and

conduction bands can be established. The energy axis intercepts of the straight lines representing phonon emission decrease with temperature, indicating a negative temperature variation of the absorption edge. Author

26 PROPELLANTS AND COMBUSTION

Includes fuels; igniters; and oxidizers. *For related information see*: 07 Chemistry; and 27 Propulsion.

N64-15267 Air Force Dept., Norton AFB, Calif.
ELECTROMAGNETIC RADIATION HAZARDS TO ELECTROEXPLOSIVE DEVICES
Reuben B. Moody *In* AF Systems Command Trans. of the 8th Symp. on Ballistic Missile and Space Technol., Vol. 2 [1963] p 411–420 refs (See N64-15251 07-01)

This paper makes an elementary evaluation of three general proposals recently made as means or techniques to diminish electromagnetic radiation hazards to electroexplosive devices. The evaluation is predicated on basic antenna theory and the improbability of accidental detonation of electroexplosive devices by radiofrequency radiation. The paper recommends the safety practices of safe-separation distances, hazard assessment through the use of inert devices, and electromagnetic shielding techniques. Author

N64-15357 Princeton U., N.J.
SOLID PROPELLANT IGNITION STUDIES: IGNITION OF THE REACTION FIELD ADJACENT TO THE SURFACE OF A SOLID PROPELLANT Final Technical Report, 1 Oct. 1962-30 Sep. 1963
Clarke E. Hermance (Ph.D. Thesis), Reuel Shinnar, and Joseph Wenograd 1 Dec. 1963 248 p refs
(AF Grant AF-AFOSR-92-63)
(Aeron. Eng. Rept.-674; AD-428602)

Discussions are presented concerning the ignition of solid propellants. Reviews of previous ignition studies are given, which include early thermal ignition theory and past experiments on the ignition of combustible mixtures. The thermal theory of ignition for homogeneous and heterogeneous systems is discussed as is a simplified model for the thermal ignition of a diffusion flame near a cool surface. Reviews are given of recent research on the mechanism of solid-propellant ignition and of experiments on the ignition of composite solid propellants convectively heated in a shock tunnel. C.L.W.

N64-15423 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
THERMAL DECOMPOSITION AND BURNING OF AMMONIUM PERCHLORIDE
A. A. Snidlovskiy and L. F. Shmagin 19 Feb. 1963 9 p refs Transl. into ENGLISH from Izvest. Vyssh. Ucheb. Zaved., Khim. Tekhnol. (Moscow), v. 5, no. 4, 1962 p 529–532
(FTD-TT-62-1902/1+2+4; AD-298657)

Catalytic additions of compounds formed from elements with a variable valence, such as Cu_2Cl_2 and MnO_2, considerably lower the flash point of ammonium perchlorate. Ammonium perchlorate does not burn at atmospheric pressure, room temperature, and a tube diameter of 22 mm, without such additions. It burns under these conditions when not less than 5% MnO_2 or $KMnO_4$, not less than 2% $CuCl_2 \cdot 2H_2O$, or not less than 0.5% Cu_2Cl_2 (the last addition was tested with a tube diameter of 34 mm) is added. The addition of 20% glucose to ammonium perchlorate (with a catalytic addition of Cu_2Cl_2) only slightly increases its burning velocity. This fact indicates that the primary process is the burning of ammonium perchlorate as an individual substance, whereas oxidation of the combustible substances is a secondary process accomplished by the combustion products of ammonium perchlorate. Author

N64-15528* National Aeronautics and Space Administration, Washington, D.C.
INVESTIGATION OF MECHANISMS OF POTENTIAL AIRCRAFT FUEL TANK VENT FIRES AND EXPLOSIONS CAUSED BY ATMOSPHERIC ELECTRICITY
Melvin Gerstein (Lockheed–California Co.) Jan. 1964 185 p refs
(NASA Contract NASr-59)
(NASA TN D-2240) OTS: $3.00

A study has been conducted to determine the important mechanisms involved in the ignition of fuel vapors issuing from a fuel tank vent under conditions of atmospheric electrical activity. The study included a literature review and experimental and analytical investigations of (1) the mixing of the fuel vent effluent with ambient air for three vent configurations at simulated flight conditions; (2) the electrical environment in the vicinity of an aircraft during lightning activity, including measurements of the far field pressures associated with a high energy discharge; (3) a study of ignition and flame propagation through channels smaller than the normal quenching distance using high energy spark sources; and (4) a study of simulated lightning discharges as to their capability of producing flames that can propagate through a typical fuel vent with and without a flame arrester. Author

N64-15598 Sandia Corp., Albuquerque, N. Mex.
CLOSE-IN PHENOMENA OF BURIED EXPLOSIONS Final Report
1 May 1963 158 p refs
(Contract DASA-EO-300-61; ARPA Order 172-61)
(DASA-1382; SC-4907(RR))

Hydrodynamic shock pressure gages were investigated, and the dynamic response of geologic solids to large-amplitude stress waves has been studied. Instrumental development was directed towards long-period displacement gages, and an analysis was made of shock waves in solid media. An impedance-mismatch-pressure gage has been developed that is capable of measuring peak shock-wave pressures of amplitude 0.1 to 1 megabar in the hydrodynamic region about buried explosions. A quartz-crystal technique for the measurement of stress-wave profiles in metals has been adapted for studies of stress waves in rock materials. A cursory examination was made of three rock materials to investigate the properties that characterize nonfluid, nonelastic stress-wave propagation. The instrument development for observation of long-period earth displacement produced by underground explosions was directed toward relative displacement devices, inertial displacement gages, and electronic single- and double integrators. C.L.W.

N64-15607 Bureau of Mines, Bartlesville, Okla. Petroleum Research Center
USE OF TRITIUM TRACER TECHNIQUES IN STUDIES OF GASOLINE STORAGE STABILITY
Charles S. Allbright, Marvin L. Whisman, and Frank G. Schwartz 1964 21 p refs
(BM-RI-6373)

Radioactive tracer techniques were used to gain a better knowledge of the types of compounds that cause gum formation in gasoline during storage. A selected organic compound

was labeled with tritium and purified. An unstable gasoline was tagged by adding a small amount of the labeled compound. After storage of the gasoline at 110° F for 16 weeks, the gum that had formed was recovered. The amount of the test compound converted to gum was determined by liquid scintillation counting. About 70 compounds, including several classes and types, were studied. The compounds, listed in order of descending reactivity in the test fuel, were sulfur compounds, nitrogen compounds, polycyclic hydrocarbons, olefins, alkylbenzenes, and saturates. In the order of decreasing percentage of each in the gum, the compounds were monoolefins, alkylbenzenes, sulfur compounds, polycyclic hydrocarbons, nitrogen compounds, and diolefins. Author

N64-15691 Lockheed Propulsion Co., Redlands, Calif.
SOLID PROPELLANT STRUCTURAL INTEGRITY INVESTIGATIONS, DYNAMIC RESPONSE AND FAILURE MECHANISMS Research Status Report No. 10, 21 Oct.-20 Nov. 1963
J. E. Fitzgerald [12 Dec. 1963] 9 p
(Contract AF 04(611)-8539)
(LPC-618-P-10)

Measurement of sinusoidal viscoelastic moduli has been completed for Polycarbutene-R propellant at temperatures from −46° F to +138° F. Good agreement has been obtained between dynamic moduli calculated from shear stress relaxation and directly measured shear dynamic moduli for the same sample. Stress relaxation characterization has been completed for the Polycarbutene-R cross-link density and recast oxidizer particle size formulation variations. Significant variations in relaxation response are observed for the cross-link density variations. A critical defect radius of approximately 0.02 in. was found to be the most acute fracture concentration that could be induced in PBAA propellant artificially or by tearing. Author

N64-15735 Southwest Research Inst., San Antonio, Tex.
REVIEW OF LITERATURE ON STORAGE AND THERMAL STABILITY OF JET FUELS
Robert K. Johnston and E. L. Andrson Wright-Patterson AFB, Ohio, Research and Technology Div., Jan. 1964 35 p refs
(Contract AF 33(657)-11246)
(RTD-TDR-63-4270; AD-429937)

A selective review has been made of the technical literature on storage and thermal stability of jet fuels, in order to provide background for a current experimental program on the effect of additives on JP-6 fuel deterioration. The literature review and the experimental program are directed primarily toward information on deterioration of thermal stability during normal storage. The subjects reviewed include thermal-stability test methods, storage stability and deterioration of thermal stability, additives for improvement of thermal and storage stability of jet fuels, and special storage problems. Author

N64-15904* Guggenheim Labs., Princeton, N.J.
A THEORETICAL STUDY OF UNSTEADY DROPLET BURNING: TRANSIENTS AND PERIODIC SOLUTIONS
Warren C. Strahle [1963] 258 p refs
(NASA Grant NsG-99-60)
(NASA CR-55516; Aeron. Eng. Rept. 671) OTS: $16.50 ph, $7.94 mf

Through unsteady analysis, conditions are established whereby it is possible to consider that droplets vaporize and burn in a nearly steady state during most of their lifetime. Periodic solutions are then obtained when the droplet is burning in an unsteady acoustic field of the ambient gas. It is shown from the periodic solutions that extremely strong response of the vaporization rate and burning rate can occur throughout the frequency spectrum. Application to the problem of combustion instability is indicated. Author

N64-16041 Army Missile Command, Redstone Arsenal, Ala. Redstone Scientific Information Center
THE SENSITIVITY OF SOME EXPLOSIVES TO A SHOCK WAVE
V. S. Ilyukin and. P. F. Pokhil 22 Jan. 1964 8 p refs Transl. into ENGLISH from Dokl. Akad. Nauk. SSSR (Moscow), v. 140, no. 1, 1961 p 179–180 refs
(RSIC-122; AD-430578)

Detonations were transferred through copper barriers from one explosive (active) to another explosive (inert) to determine their sensitivity to shock waves. Results demonstrated that the initial shock wave heats the tested explosive up to a temperature that insures a short delay in ignition and a rapid chemical decomposition. R.T.K.

N64-16052 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
CHLORINE AND HYDROGEN EXPLOSION TEMPERATURES AND LIMITS IN HYDROGEN CHLORIDE
T. I. Kunin and V. I. Serdyukov 21 Nov. 1962 13 p refs Transl. into ENGLISH from Zh. Obshch. Khim. (Moscow), v. 16, no. 9, 1946 p 1421–1430
(FTD-TT-62-1415/1+2; AD-292616)

The limits of explosion of chlorine–hydrogen mixtures in a medium of hydrogen chloride have been investigated. The effect of admixtures of CO_2, N_2, O_2, and water vapor on the change of the explosive properties of the investigated mixtures has been studied. Author

N64-16059 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
THE INFLUENCE OF CHEMICAL COMPOSITION AND ADMIXTURES ON THE COMBUSTION OF FUEL IN JET ENGINES
Ya. M. Paushkin, R. V. Sychev, T. P. Vishnyakova, and A. K. Zhomov 24 Oct. 1962 27 p refs Transl. into ENGLISH from Sb. Tr., Mezhvuz. Soveshch. po Khim. Nefti (Moscow), 1960 p 293–314
(FTD-TT-62-743/1+2+4; AD-292214)

According to Sommerfield's theory, the stability of operation of liquid-fuel jet engines is achieved at small values for the induction period (the induction period must be less than a certain relationship between the parameters of the engine). The induction period of a fuel depends upon its chemical composition; it is least for organic self-igniting fuels, i.e., self-igniting with nitric acid. Among the hydrocarbons, only diene compounds and terpenes are self-igniting with nitric acid (for example, cyclopentadiene and its polymers). Petroleum products are not self-igniting with nitric acid at normal ignition temperatures. Fluorine and fluorine compounds are oxidizers that guarantee the self-ignition of all organic fuels, including petroleum products. Data are presented on the combustion efficiency and the self-ignition temperature of various hydrocarbons, the relative sooting and ignition lag time for various fuels, and the ignition temperature and lag of droplets of fuels falling in nitric-acid vapor. Also, a special apparatus for determining the self-ignition temperature and ignition lag of organic substances with nitric acid at high temperatures is described. I.v.L.

N64-16080 Hercules Powder Co., Kenvil, N.J.
DEVELOPMENT OF HIGH TEMPERATURE-RESISTANT PROPELLANTS [Final Report]

R. L. Simmons Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Jan. 1964 36 p ref
(Contract DA-36-038-507-ORD-3572M; Contract AF 33(657)-2-R&D-111)
(RTD-TDR-63-4209; FA-R-1703; AD-430591)

Trimene Base was found to be a more effective curing agent for potassium perchlorate/Hycar 4021 propellants than DMP-30 and sulfur. Propellant HES-6573 utilizing this approach performed satisfactorily in M73 PAD cartridges in firings from −65° to 400° F. Hycar 1051 was successfully cross-linked with triallyl cyanurate, but the resulting propellant binders did not provide increased heat resistance over the straight Hycar 4021/Trimene Base system. Propellants with silicone and fluorocarbon binders possessed superior heat resistance to the Hycars, but lacked energy. Cyclotetramethylene tetranitramine (HMX) was found to have promise as an organic heat-resistant oxidizer in a Hycar binder where it gave greater impetus than potassium perchlorate; however, burning rate was considerably slower. Limited studies were made for processing the extrudable Hycar propellants in grains up to 1-in. diam. and in fine granulations as small as 0.04-in. diam. for fast-burning applications. Author

27 PROPULSION

Includes airbreathing, electric, liquid, nuclear, and solid propulsion. *For related information see*: 04 Aircraft; 06 Auxiliary Systems; 26 Propellants and Combustion; and 30 Space Vehicles.

N64-15065 Army Missile Command, Huntsville, Ala. Test and Reliability Evaluation Lab.
ARDE-PORTLAND LITHIUM COOLED NOZZLE PROGRAM. Final Report
Ronald G. Eyestone and Robert C. Hamlett Dec. 1963 50 p
(RT-TR-63-13; AD-428102)

Tests were conducted to determine the feasibility of cooling a solid-propellant motor nozzle using liquid lithium as a cooling agent. Damage to the cooled nozzle was so severe that no concrete conclusions could be drawn from this test program. Author

N64-15303* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
EFFECTS OF MOLECULAR FLOW IN PLASMA GENERATION AND SOME ANALYSES OF SPACE CHARGE FLOW IN ION ACCELERATION
Edward A. Richley and William R. Mickelson N.Y., Am. Inst. of Aeron. and Astronautics [1964] 12 p refs Presented at the AIAA Aerospace Sci. Meeting, N.Y., 20–22 Jan. 1964
(AIAA Paper 64-7) AIAA: $0.50 members, $1.00 non-members

The role of molecular flow in electron-bombardment ion chambers is discussed, and some inferences are derived from postulated flow models. These inferences are compared with experimental results obtained from ion chambers. A digital computer program for solving two-dimensional and axisymmetric space-charge flow problems is presented. Solutions are given for some contact-ionization thrustor configurations operating under space-charge-limited modes and less than space-charge-limited modes. Author

N64-15381 Calorobic Materials, Inc., Pearl River, N.Y.
DEVELOPMENT AND UTILIZATION OF OPTIMUM TECHNIQUES FOR THE FABRICATION OF TITANIUM BORONITRIDE ROCKET NOZZLES First Interim Report, Jan. 1-Jun. 30, 1963
R. Strickman Jul. 1963 20 p
(Contract DA-30-069-ORD-3747)
(TR-371.9/6; AD-429467)

All the test specimens, the HTB-2 rocket nozzle inserts and three of the 1-in. throat diameter HTB-3 nozzle inserts were made by the conventional method in accordance with specifications. In the scale-up of the operation to produce larger throat diameter nozzle inserts, a proprietary method involving core heating was employed. Using this method, the apparatus was designed and constructed, and 1-in. throat diameter nozzles were produced. Author

N64-15556 Gt. Brit. Ministry of Aviation, Mottingham Technical Information and Library Services
GAS DYNAMICS MIXING PROCESSES. THRUST INCREASE BY JET MIXING [GASDYNAMISCHE MISCHUNGSVORGANGE. SCHUBERHOHUNG DURCH STRAHLBEIMISCHUNG]
O. Lutz Jan. 1964 14 p refs Transl. into ENGLISH
(TIL/T-5349; DFL-86)

Gas dynamic mixing is considered using graphical-numerical analysis. The processes in both subsonic and supersonic conditions are described. Special attention is given to the discontinuous mixing of two gas flows in a cylindrical mixing length where the momentum theorem and theorem of conservation of energy are no longer compatible. It is shown that the zone of discontinuous mixing also provides a clear picture of the zones in which increases or decreases of pressure occur during mixing. The zones showing a pressure increase can be used for increasing the thrust of jet engines; the extent of this increase shows that in certain cases a matching of the engine cowling can be advantageous, especially in supersonic flight. Author

N64-15623* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
PERFORMANCE ANALYSIS OF CHEMICAL STAGES IN THE 300 TO 400 SECOND SPECIFIC IMPULSE RANGE FOR INTERPLANETARY MISSIONS
Walter H. Stafford and Carmen R. Catalfamo Washington, NASA, 5 Feb. 1964 69 p refs
(NASA TM X-53002)

This report presents a procedure by which trajectory parameters can be determined for escaping from, and braking into, an orbit about the earth utilizing a single vehicle stage in the low specific impulse range. The effect of thrust-to-weight ratios and specific impulses on trajectory parameters was investigated for hyperbolic velocities. For the escape trajectories, the thrust vector was applied tangential to the flight path and in the direction of the velocity vector. For the braking trajectories, the thrust vector was directed against the velocity vector. The approach used for the escape trajectories was to determine the trajectory parameters at burnout, convert the characteristic velocity to a hyperbolic excess velocity, and then present the data graphically. The approach used for the braking trajectories was to determine the arrival velocity for a given transfer trajectory and initiate burning such that circular orbit conditions are attained at burnout; the characteristic velocity is converted to a hyperbolic excess velocity and presented graphically. Author

N64-15764 Battelle Memorial Inst., Columbus, Ohio Defense Metals Information Center
A REVIEW AND COMPARISON OF ALLOYS FOR FUTURE SOLID-PROPELLANT ROCKET-MOTOR CASES
F. J. Barone, et al 15 Nov. 1963 44 p refs
(DMIC-Memo-184; AD-430165)

Metallic materials for solid-propellant rocket-motor cases in the period 1965 to 1970 probably will be confined to steel and alloys of titanium and aluminum. Of the three, titanium alloys have the greatest potential on the basis of usable strength-to-density ratio, followed by steel and aluminum alloys. Of the potential steel alloys, by far the most of the current development work is being done on the 18-percent nickel maraging steels. These steels have the promise of good fracture toughness at high strength levels, and perhaps most important, their heat treatment is favorable for the fabrication of very large boosters, compared to steels that must be austenitized after forming. Author

N64-15782* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
FUEL-CONTAINMENT REQUIREMENTS FOR GASEOUS-FUEL NUCLEAR ROCKETS
Robert V. Meghreblian 2 Sep. 1963 15 p refs
(NASA Contract NAS7-100)
(JPL-TR-32-441; NASA CR-53067) OTS: $1.10 ph, $0.80 mf

Fuel-containment requirements for open-cycle gaseous-fuel nuclear rockets are examined for systems in which there is physical contact between propellant and fuel. Such systems necessarily allow some loss of nuclear material. Analysis shows that the total fuel lost during the propulsion period is the prime constraint in determining containment requirements. A parameter, the containment factor, is introduced to provide a measure of fuel-containment efficiency. Application to representative high-thrust (booster) and low-thrust (interplanetary) vehicles is considered. The analysis indicates that containment factors fifty times as large as those presently demonstrated experimentally are required, in order to limit nuclear fuel loss during propulsion to the order of 1,000 kg. Author

N64-15910* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
EXPERIMENTAL EVALUATION OF STEADY-STATE CONTROL PROPERTIES OF AN ELECTRON-BOMBARDMENT ION THRUSTOR
Shigeo Nakanishi, Eugene V. Paulik, and Charles W. Baur Washington, NASA, Feb. 1964 61 p refs
(NASA TN D-2171) OTS: $1.50

Examined in this report are the experimental steady-state gains, or changes, in beam-current output with changes in thrustor inputs for a 10-cm-diam electron-bombardment ion thrustor. A general leveling off of beam current as a function of an input variable was found at the upper range of each variable. At the design operating point, the filament-heating current exhibited the greatest sensitivity, or percentage beam-current output change for a percentage change in the input (2 to 4). Accelerator voltage showed the least effect (0.04), and discharge voltage, magnetic field, and neutral propellant flow exhibited about the same sensitivity (0.4 to 0.5). Some effects of nonlinearity are shown that may require consideration in the design of a closed-loop control system. Author

N64-15949 Library of Congress, Washington, D.C. Aerospace Information Div.
ELECTROSTATIC ROCKET TECHNOLOGY. COMPREHENSIVE REPORT ON SOVIET PERIODICAL LITERATURE Report No. 1, Jan. 1958-Apr. 1963
10 Dec. 1963 75 p refs
(AID P-63-121; AD-429317) OTS: $7.60 ph, $2.45 mf

Reviews are given of studies in the following areas: experiments with a laboratory model of an ion-propulsion motor; ion production, ion optics, and ion beam neutralization; charge exchange; and secondary emission. A laboratory model of an ion motor was used to study thrust generation by accelerating cesium ions produced through contact ionization of cesium vapor on a heated tungsten plate. Studies were conducted on the surface ionization of lithium, sodium, potassium, and rubidium and on ion sources for use in mass spectrometers. Several theoretical analyses of space-charge flow and focusing systems are presented, along with automatic space-charge flow calculation and trajectrographs. Studies are also included that deal with the theoretical and experimental determination of plasma oscillations arising in the neutralization of ion beams; charge exchange between alkali-metal ions and atoms or various gases; and secondary emission from metal surfaces bombarded with ion beams. C.L.W.

N64-16027* General Electric Co., Philadelphia, Pa. Space Science Lab.
REPETITIVELY PULSED 2-STAGE PLASMA ENGINE Second Quarterly Progress Report, 1 Sep.-30 Nov. 1963
B. Gorowitz, P. Gloersen, J. Kenney and A. Ruess [1963] 8 p
(NASA Contract NAS3-3570)
(NASA CR-55771) OTS: $1.10 ph, $0.80 mf

Calorimetric measurements of overall efficiency were carried out on an accelerator that was operated with a newly installed electromagnetic fast-acting valve. A marked increase in efficiency, particularly at the lower voltages, was indicated. Further attempts were made to enhance propellant loading characteristics in the accelerator. The single shot facility, primarily for the measurement of magnetic and electric field transients, was placed in operation, and probe studies were commenced. Author

N64-16040 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
FOUNDATIONS OF CONTEMPORARY AND FUTURE ROCKET PROPULSION SYSTEMS
G. Schubart 11 Oct. 1963 126 p refs Transl. into ENGLISH from the publ. "Grundlagen der Gegenwaertigen und Zukunftigen Raketenantriebe" Dresden, Zentralstelle für Lit. und Lehrmittel, 1958 p 1-103
(FTD-TT-63-455/1+2+3+4; Ad-426394; Forschungszentrum der Luftfahrtindustrie Rept. and Lectures 4; Kammer der Tech. Rept. 10)

The following are discussed with respect to present-day and future rocket propulsion: (1) general principles of rocket propulsion; (2) basic equation for rockets; (3) thrust nozzles; (4) solid-propellant rockets; (5) liquid-fuel rockets; (6) nuclear-thermal rockets; (7) heating by solar energy; (8) arc heating; (9) ion propulsion; and (10) photon propulsion. P.V.E.

N64-16078 Aerospace Corp., El Segundo, Calif. Aerodynamics and Propulsion Research Lab.
GENERAL RESEARCH: ELECTRON BOMBARDMENT HEATING FOR ELECTROTHERMAL PROPULSION
K. E. Starner and W. R. Grabowsky 3 Feb. 1964 49 p refs
(ATN-64(9227)-3; AD-430482)

Electrothermal propulsion devices developed to date can be grouped into two classifications, namely, the arc jet and the electrical resistance-heated heat-transfer propulsor. The former type features Joule heating directly in the gas; in the latter, a resistance-heated refratory-metal heat exchanger transfers heat to the propellant by conduction. This report introduces the technique of high-voltage, low-current electron bombardment heating for the heat-transfer thrustor. A

tantalum, electron-bombardment-type gas heater was built to research thrustor operation. Steady-state gas temperatures to 2700° Kwere produced with argon at a voltage-to-current ratio greater than 50. The device functioned successfully for a total operating time of approximately 50 hr. Author

28 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. *For related information see*: 05 Astronomy and Astrophysics; 16 Life Sciences; and 29 Space Sciences.

N64-15087 Southwestern Coll., Memphis, Tenn.
OBSERVATIONS OF NEAR INFRARED RADIATION FROM THE SOLAR ATMOSPHERE
J. H. Taylor *In its* Time-Dependent Infrared Studies Dec. 1963 p 123–128 refs (See N64-15085 07-01)

Using the High Altitude Observatory's recently completed 16-in.-diam. coronagraph in conjunction with a Perkin–Elmer Model 12C infrared spectrometer, observations of the radiation from the solar atmosphere have been made in the infrared region of the spectrum from 0.936 to 2.173 μ. Spectra were obtained using a DF-2 prism and PbS detector. Spectra from the solar atmosphere and photosphere are compared. Uncertainties in the spatial origin of these recorded spectra are discussed. Author

N64-15175* General Mills, Inc., Minneapolis, Minn. Electronics Div.
MODIFICATION OF THE LUNAR SURFACE BY THE SOLAR-WIND BOMBARDMENT
G. K. Wehner, C. E. Kenknight, and D. Rosenberg Repr. from Planet. Space Sci., v. 11 1963 p 1257–1261 refs
(NASA Contract NASw-424)

Long-duration, solar-wind sputtering conditions were simulated at a much accelerated scale with mass-separated hydrogen ion beams or in low-pressure, noble gas or hydrogen plasmas. Experiments with metal targets and metal-, oxide-, and rock-powder samples demonstrate the leveling and smoothing of macroscopic surface features and cementing together of loose particles into a porous, brittle, fibrous crust. Certain oxide surfaces become enriched with metal atoms under the bombardment and sputtering action. It is concluded that many of the unusual properties of the lunar surface can be explained by the action of solar-wind bombardment. Author

N64-15185* California U., Los Angeles Inst. of Geophysics and Planetary Physics
HYDROMAGNETIC WAVES IN SPACE
Gordon J. F. Mac Donald *In its* Notes for the Summer Inst. In Planetary Phys. 1963 50 p refs (See N64-15182 07-01)
OTS: $21.00 ph, $11.03 mf

Waves in a compressible, nondissipative, hydromagnetic medium is described. The detailed geometry of the wave solutions are described, and the observable properties of the waves are considered. The problem of the refraction and reflection of hydromagnetic waves at sharp boundaries is also considered. Also discussed are the hydromagnetic waves at the surface of the earth and of satellites. R.T.K.

N64-15269 Tokyo Astronomical Observatory (Japan)
ON PHYSICAL CONDITIONS IN THE CORONA ABOVE AN ACTIVE REGION REFERRING TO THE RADIO OBSERVATIONS
Masaki Morimoto *In its* Ann. of the Tokyo Astron. Obs., 2d Ser., v. 8, no. 2 1963 p 125–144 refs (See N64-15288 07-05)

Heights of type III bursts in a range between 517 and 45 Mc give a distribution of critical electron densities of about 30 times the values of the normal corona. Heights of noise storms are systematically lower than those of type III bursts. Type I bursts have a stronger limb darkening than type III bursts. At 45° in the heliographic longitude, intensities of type I bursts at 200 Mc drop by a factor of 1/20 while those of type III bursts at 200 and 60 Mc drop by a factor of 1 and 1/1.8, respectively. A possible model of the corona above an active region (coronal streamer) is proposed. Electron densities are 10 and 30 times the values of the normal corona in a typical streamer and in the filament embedded in the streamer, respectively. Plasma oscillations near the surfaces of the filamentary condensations embedded in the streamer are suggested as the radio sources for type III and type I bursts. Author

N64-15283 Naval Research Labs., Washington, D.C.
THE VAN ALLEN RADIATION BELTS
Cabell A. Pearse *In* Georgetown U., Washington, D.C. Recent Advances in Astro-Geophysics [1961] p 48–59 refs (See N64-15276 07-01)

A description is given of Van Allen experiments and the results obtained; the behavior of charged particles in magnetic fields, in particular, the earth's magnetic field, is considered. R.T.K.

N64-15292 Maryland U., College Park
COSMIC RADIATION
David P. Stern *In* Georgetown U., Washington, D. C. Recent Advances in Astro-Geophysics [1961] p 117–130 refs (See N64-15276 07-01)

Various theories exist for the explanation of cosmic radiation. The best known ones are: (1) betatron acceleration proposed by Swann, which assumes that CR (cosmic radiation) particles are accelerated by rapidly varying stellar magnetic fields; (2) statistical acceleration, due to Fermi, in which CR is accelerated by random collisions with ionized gas clouds in space; and (3) supernova production, developed by Ginzburg and others, in which the energies of C.R. are generated by hydromagnetic processes in the expanding envelope of a supernova. These theories apply to primary cosmic radiation. The radiation detected deep in the atmosphere consists almost exclusively of secondary products. This aspect of cosmic-ray physics is reviewed briefly. The properties of C. R. particles produced by solar flares are also discussed. R.T.K.

N64-15420 Northrop Corp., Hawthorne, Calif. Space Labs
RADIATION HAZARDS IN SPACE
Robert E. Fortney and Mac R. Morrison [1963] 20 p refs Presented at the Joint AMD/ASD Conf. on Crew Escape Techniques for Aerospace Vehicles, Dayton, Ohio, 19–20 Feb. 1963
(AD-428574)

The assumptions that are normally made in dose calculations are clarified, and the hazards associated with Van Allen protons and solar flares are evaluated. Conclusions reached as a result of this study are: (1) The primary hazard of the Van Allen protons is to the blood-forming organs; one-half day is the maximum time that can be spent at the heart of the belt

under 4 gm/cm^2 aluminum before NASA's design dose to the blood-forming organs (50 rads) is exceeded. (2) The primary hazard of solar-flare protons is to the skin of the astronaut, and due to the variability of solar flares, quantitative assessment is presently not feasible. P.V.E.

N64-15428 National Bureau of Standards, Boulder, Colo.
THE OCCURRENCE OF POLAR CAP ABSORPTION
D. K. Bailey and J. M. Harrington (Page Commun. Engr., Inc.) *In* Agard, Paris The Effect of Disturbances of Solar Origin on Commun. 1963 p 21–24 refs (See N64-15426 07-08)

Preliminary statistics of the occurrence of polar cap absorption (PCA) events from 1952 to 1960 are presented, based on the field-strength recordings of ionospheric forward scatter links. A total of 21 PCA's of medium and larger intensity have been discovered. The correlation of the size of PCAs to the intensity of cosmic ray bursts as observed simultaneously on ground level is poor. Author

N64-15443 Max-Planck-Institut für Aeronomie, Lindau über Northeim (W. Germany)
ON THE INFLUENCE OF DISTURBANCES OF SOLAR ORIGIN ON OBLIQUE-INCIDENCE PULSE TRANSMISSION
W. Dieminger, H. G. Moller, and G. Rose *In* Agard, Paris The Effect of Disturbances of Solar Origin on Commun. 1963 p 193–206 refs (See N64-15426 07-08)

During the IGY, multifrequency pulse transmissions and simultaneous backscatter observations were carried out over two paths, from Lindau, Germany, 2,000 km to Finland, and from Lindau, 8,000 km to southwest Africa. The effects of solar flares, simultaneous and delayed, are described and interpreted. Author

N64-15445 National Bureau of Standards, Boulder, Colo. Central Radio Propagation Lab.
RELATION OF SOLAR ACTIVE REGIONS AT CENTRAL MERIDIAN PASSAGE TO IONOSPHERIC DISTURBANCE
Constance S. Warwick and J. V. Lincoln *In* Agard, Paris The Effect of Disturbances of Solar Origin on Commun. 1963 p 229–233 refs (See N64-15426 07-08)

This paper describes some of the differences in solar–terrestrial relationships during years of high solar activity and during years of low solar activity. Clear relations between individual solar events and geomagnetic disturbance are found at times of high activity, whereas only relatively weak relations are present at times of low activity. However, in the low activity years, 27-day recurrence patterns are established. The radio propagation effects accompanying geomagnetic disturbances at the different times of the cycle are briefly discussed. Author

N64-15446 Fernmeldetechnisches Zentralamt, Darmstadt (W. Germany)
ON THE 27 DAYS RECURRENCE TENDENCY OF RADIO PROPAGATION DISTURBANCES IN THE PERIOD OF HIGH SOLAR ACTIVITY
A. Ochs and B. Beckmann *In* Agard, Paris The Effect of Disturbances of Solar Origin on Commun. 1963 p 235–244 refs (See N64-15426 07-08)

A report is given on some statistical investigations dealing with the radio propagation quality figures determined for the North Atlantic path by the Fernmeldetechnisches Zentralamt (FTZ) and the Central Radio Propagation Laboratory (CRPL). The quality figures of the FTZ show the recurrence tendency, present even in the period of high solar activity, much clearer than those of the CRPL. During high activity, the recurrence is less pronounced and more irregular than during the period of low solar activity, in the course of the sunspot cycle. Notwithstanding, when used in addition to the evaluation of the various other solar and geophysical phenomena, it gives valuable assistance in forecasting propagation disturbances, even during the sunspot maximum. A description of the method used by the FTZ for evaluating the quality figures is given. Author

N64-15447 Air Force Cambridge Research Labs., Bedford, Mass. Office of Aerospace Research
CLASSIFICATION OF IONOSPHERIC STORM TYPES (AND TYPE-DEPENDENCE ON SOLAR-GEOMAGNETIC PHENOMENA)
R. J. Cormier *In* Agard, Paris The Effect of Disturbances of Solar Origin on Commun. 1963 p 245–259 refs (See N64-15426 07-08)

Ionospheric storms are classified into various types dependent on the amount of shrinkage or expansion of the useful HF frequency spectrum (Concord Storm Index), for the days of the storm period. A total of 15 storms was analyzed, and 2 major types—positive, showing contracted useful spectrum, and negative, showing expanded useful spectrum (in reverse of Sato's nomenclature)—as well as 3 minor types, are shown. The type of storm seems dependent on the percentage change, rather than on the absolute magnitude, of the magnetic activity. Certain type storms are associated with observed flares and the resultant cosmic ray indices; also there appears to be a preferred location of the flare on the sun's disk for certain types of ionospheric storms. Author

N64-15451 National Bureau of Standards, Boulder, Colo.
ON THE EFFECT OF SOLAR DISTURBANCES ON THE LOW-RADIO-FREQUENCY IONOSPHERE REFLECTION PROCESS
J. R. Johler and J. D. Harper, Jr. *In* Agard, Paris The Effect of Disturbances of Solar Origin on Commun. 1963 p 303–334 refs (See N64-15426 07-08)

A flexible theoretical model plasma, which can be deformed to fit almost any measured electron–ion altitude profiles, is employed together with available geophysical data on the ionosphere to evaluate reflections and transmissions during quiescent and disturbed propagation conditions. The reflection and transmissions in the ionosphere are determined rigorously with the aid of the classical magnetoionic theory. The corresponding reflection and transmission coefficients are then calculated, and certain phenomena, which can be expected as a result of the action of a solar disturbance on the reflection process, are predicted. The particular disturbance, investigated to illustrate application of technique, was found to influence the reflection of transmitted LF waves in the lower ionosphere in a complicated manner. However, the high absorption phenomena exhibited by high frequencies do not seem to exist for the plasma profiles investigated at LF with the classical magnetoionic theory. Author

N64-15531* Space Technology Labs., Inc., Redondo Beach, Calif. Quantum Physics Lab.
THEORETICAL STUDY OF THE COUPLING BETWEEN THE SOLAR WIND AND THE EXOSPHERE Quarterly Status Report No. 2, 14 Sep.-11 Dec. 1963
F. L. Scarf 11 Dec. 1963 30 p Submitted for Publication
(NASA Contract NASw-698)
(NASA CR-55683; Rept. 8494-6002-SU-000) OTS: $2.60 ph, $1.10 mf

It has been suggested that charge separation electric fields in the Chapman–Ferraro sheath generate currents that are large enough to trigger the two-stream plasma instability. It

is argued that as the electric field energy becomes saturated, the drift energy is lowered and the electron temperature rises so that the instability is generally not quenched. Instead, it can change form, leading to growing ion waves. The equilibrium state then involves fluctuating electromagnetic fields that allow "fast" plasma diffusion across the main magnetic field. In this case, the exospheric thermal plasma, together with the part of the solar-wind plasma that has attained energy equipartition, can form current systems leading to a broad, disordered transition region between the magnetosphere and the solar wind. Author

N64-15700* Iowa State U., Iowa City
CHANGES IN THE STRUCTURE OF THE OUTER RADIATION ZONE ASSOCIATED WITH THE MAGNETIC STORM OF SEPTEMBER 30, 1961
W. G. V. Rosser Repr. from J. Geophys. Res v. 68, no. 10, 15 May 1963 p 3131–3148 refs
(NASA Grant NsG-233-62)

After the magnetic storm of September 30, 1961, a turbulent solar plasma was observed beyond the limits of the outer radiation zone. The evidence suggests that the outer boundary of the geomagnetic cavity contracted during the period immediately after the storm owing to the arrival of excess solar plasma. On October 2, 1961, the radial extent of trapping extended beyond a geocentric distance of 80,000 km. It is suggested that this expansion of the geomagnetic cavity may be due to the presence of a diamagnetic ring current. After the magnetic storm the intensity of electrons > 1.6 Mev detected by the 302 GM counter decreased by a factor of 1000 at $L = 4.5$. The counting rate of the 302 GM counter then increased slowly over a period of days, but had not returned to its prestorm values at $L = 4.5$ by October 6, 1961. Author

N64-15715 Joint Publications Research Service, Washington, D.C.
THE STUDY OF COSMIC RAYS (CONFERENCE IN MOSCOW)
A. A. Pomanskiy *In its* New Develop. in the Earth Sci. 26 Feb. 1964 p 8–12 (See N64-15713 07-01) OTS: $0.50

This conference was devoted to both cosmophysical and nuclear trends in the study of cosmic rays. Reports devoted to basic trends in investigations and the results of individual experimental or theoretical work are summarized. R.T.K.

N64-15719 Boeing Co., Seattle, Wash.
AN EVALUATION OF THE RADIATION HAZARD DUE TO SOLAR-PARTICLE EVENTS
W. R. Webber (Minnesota U.) Dec. 1963 109 p refs
(D2-90469; supersedes D2-11608)

A qualitative description has been given of the various methods of detecting solar-particle events, and all of the pertinent data available have been tabulated. The characteristics of each of the events have been determined, and from these the intensities and the characteristic rigidities have been estimated for each event. Based upon this information, the radiation doses have been calculated for each event, and cumulative dose-probability curves have been derived. Comments are included regarding missions in solar cycle 20 and various techniques for predicting the occurrences of solar-particle events. Author

N64-15759 Ohio State U. Research Foundation, Columbus
STELLAR BACKGROUND MEASUREMENT PROGRAM Semiannual Technical Report No. 3, 16 Jun.–15 Dec. 1963
Phillip E. Barnhart and Walter E. Mitchell, Jr. 2 Jan. 1964 8 p refs
(Contract DA-33-019-AMC-105(Z); ARPA Order-39; Proj. Defender)
(AD-427187)

Improvements were made on a 32-in. telescope, and runs were conducted to determine the effect on performance. Additional structural support was added to the photometer body to eliminate as much instrument flexure as possible. This resulted in additional weight of the photometer head and a considerable improvement in the rigidity of the instrument. The sensitivity of the photometer was improved by modification of the placement of some of the optical components. The plumbide detector was installed directly at the focus of the off-axis ellipsoidal mirror when the germanium–cadmium detector was not being used. This modification resulted in an increase in specific signal of about 40%. The signal lead from the helium-cooled detector was rewired resulting in the elimination of serious instrumental noise and microphonic pickup. The signal-to-noise ratio has been greatly enhanced, and the specific signal from the blackbody source has been increased. C.L.W.

N64-15775 International Council of Scientific Unions, Paris (France) Internatl. Committee on Geophysics (CIG)
IQSY NOTES NUMBER 2
C. M. Minnis London, Internatl. Years of the Quiet Sun (IQSY) Secretar., May 1963 79 p

This report contains the program activities of some of the countries participating in the International Years of the Quiet Sun. The programs involved are concerned with meteorology, geomagnetism, aurorae and airglow, the ionosphere, solar activity, cosmic radiation, and aeronomy. I.v.L.

N64-16023 Naval Research Lab., Washington, D.C.
NEW PHOTOGRAPHIC SPECTRA OF THE SUN IN THE EXTREME ULTRAVIOLET
R. Tousey, J. D. Purcell, W. E. Austin, D. L. Garrett, and K. G. Widing [1963] 29 p refs Presented at the COSPAR 4th Intern. Space Sci. Symp. and 6th Plenary Meeting, Warsaw, Poland, Jun. 3–12, 1963

Extreme ultraviolet solar spectra of considerably increased resolution were photographed with four spectrographs flown in an Aerobee-Hi rocket. Prints were obtained of a spectrum from 2,000 to 1,200 A. A spectrum was obtained covering the wavelength range Lyman-alpha to 1,070 A, and the grazing incidence spectrum is compared with spectra obtained through other experiments. The line profiles of hydrogen were also determined. C.L.W.

29 SPACE SCIENCES

Includes space chemistry; cosmology; lunar and planetary exploration; and theoretical analysis of orbits and trajectories. *For space biology see*: 16 Life Sciences. *For related information see*: 05 Astronomy and Astrophysics; 12 Geophysics; and 22 Navigation and Guidance.

N64-15024 Deutsche Forschungsanstalt für Luft- und Raumfahrt, Brunswick (W. Germany) Inst. für Flugzeugbau
PHYSICAL CONDITIONS AND PROCESSES AT GREAT HEIGHTS AND THEIR EFFECTS ON RAW MATERIALS [PHYSIKALISCHE BEDINGUNGEN UND VORGANGE IN GROSSEN HOHEN UND DEREN WIRKUNG AUF WERKSTOFFE]

W. Wilkens [1963] 54 p refs In GERMAN Presented at the 2nd Seminar for Space Flight Technology, Brunswick, 21–25 Oct. 1963
(DFL-218)

A survey is given of the physical conditions existing in extraterrestrial space. This survey is followed by a discussion of the effect of extremely low gas densities on the condition of spacecraft surface materials. Emphasis is placed on sublimation, external friction, and metal stability. In addition, the effect of electromagnetic and corpuscular radiation on materials is considered, and reference is made to the hazards presented to spacecraft by meteoritic particles. Trans. by I.v.L.

N64-15120 Aerospace Corp., El Segundo, Calif. Systems Research and Planning Div.
PRELIMINARY INVESTIGATIONS RELATIVE TO MULTIPLE RENDEZVOUS BETWEEN CIRCULAR ORBITS
H. L. Roth 15 Jan. 1964 36 p refs
(Contract AF 04(695)-269)
(SSD-TDR-63-179; TDR-269(4130-10)-4; AD-428859)

The temperature dependence of the absorption of the spectral lines due to pairs of chromium ions in concentrated ruby at 7009 and 7041 A is fitted to theory by assuming isotropic exchange coupling. Other frequencies predicted from the parameters thus determined are identified in the observed spectrum. Higher states are identified by means of the excitation spectrum and the spacings already known from the identification of the lower levels. To a closer approximation, it is found that the ground state splitting can be fitted within the experimental error using isotropic exchange if a biquadratic term is included, in addition to the usual quadratic term. Furthermore, the ratio of the coefficients of these terms is of the same order as that found in other materials and predicted by theory. The excited states, however, do not appear to fit a theory based on isotropic exchange coupling as the sole perturbation. Author

N64-15154 Joint Publications Research Service, Washington, D.C.
NEW INVESTIGATIONS IN OUTER SPACE
I. B. Faynboym, ed. 11 Feb. 1964 30 p refs Transl. into ENGLISH of the booklet "Novyye Issledovaniya v Kosmose" Moscow, Znaniye Publishing House, 1963 p 3–31
(JPRS-23195; OTS-64-21544) OTS: $0.75

Five articles summarize past progress and prospective developments in the physics of the atmosphere, astrophysics, cosmic biology, astronomy, and rocket engines. R.L.K.

N64-15163* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
CONSIDERATIONS OF THE MOTION OF A SMALL BODY IN THE VICINITY OF THE STABLE LIBRATION POINTS OF THE EARTH-MOON SYSTEM
William H. Michael, Jr. 1963 27 p refs
(NASA TR R-160) GPO: $0.35

On the basis of a first-order analysis of the equations of motion of the restricted three-body problem, an explicit solution is obtained for the position and velocity components of the motion as a function of the initial conditions. The results of the explicit solution lead to a determination of the properties of the motion as a function of the initial conditions. The properties so determined include the position in orbit and the velocity components as a function of time, the properties of the component elliptical motions which comprise the resultant motion, the existence of periodic elliptical orbits through proper choice of initial conditions, and the limits of the motion. Author

N64-15183* California U., Los Angeles Inst. of Geophysics and Planetary Physics
THE INTERNAL CONSTITUTIONS OF THE INNER PLANETS AND THE MOON
Gordon J. F. Mac Donald *In its* Notes for the Summer Inst. in Planetary Phys. 1963 155 p refs (See N64-15182 07-01)
OTS: $21.00 ph, $11.03 mf

The internal structures of the Moon, Mars, Venus, and Mercury are examined in the light of what is known about the constitution of the Earth. The gravitational figure of the Earth, as obtained from orbits of artificial satellites, is used to estimate the possible deviations from hydrostatic equilibrium on other planets. Observations of the orbital and rotational motion of the Moon are consistent with the hypothesis that the interior of the Moon supports density inhomogeneities of the same order as those supported by the Earth. The surface heat flow for the Earth is consistent with the hypothesis that the concentration of radioactive elements is the same as that in chondritic meteorites. The observed ratio of potassium to uranium in surface and near-surface rocks is not consistent with the chondritic hypothesis. It is concluded that a chondritic composition is not a satisfactory chemical model for the inner planets. R.T.K.

N64-15195 Minneapolis-Honeywell Regulator Co., Minn. Military Products Group
PARTICULAR SOLUTIONS OF THE GENERAL PROBLEM ON THE TRANSLATIONAL-ROTATIONAL MOTION OF A SPHEROID ATTRACTED BY A SPHERE
V. T. Kondurar' [1962] 21 p refs Transl. into ENGLISH of an article from Astron. Zh. (Moscow), v. 36, no. 5, 1959 p 890–901
(MH Trans-60)

This study presents a particular solution of the translational–rotational motion for the two-body problem in which the satellite is a spheroid, and the planet is a sphere. Author

N64-15260 Aerospace Corp., El Segundo, Calif.
ORBIT DETERMINATION ERROR ANALYSIS
D. R. Speece *In* AF Systems Command Trans. of the 8th Symp. on Ballistic Missile and Space Technol., Vol. 2 [1963] p 197–228 (See N64-15251 07-01)

The problem of orbit determination by radar tracking data is broken into its constituent parts, which are then subjected to detailed examination. The behavior of orbital errors is interpreted in terms of the influence of their sources and the nature of their propagation. Conclusions are based on the results of a large number of digital simulations with the Aerospace TRACE program and the General Electric Pat-B program, plus limited experience in the reduction of "live" data from the SCF net. Author

N64-15262 Cook Electric Co., Morton Grove, Ill. Tech-Center Div.
A RECOVERY SYSTEM FOR A CONTROLLED DESCENT THROUGH THE MARTIAN ATMOSPHERE
R. D. Turner *In* AF Systems Command Trans. of the 8th Symp. on Ballistic Missile and Space Technol., Vol. 2 [1963] p 263–291 (See N64-15251 07-01)
(NASA Contract NAS7-100)

This paper presents a summary of a parametric investigation of a parachute recovery system for a Mars entry vehicle. The parameters that were investigated were entry vehicle velocity, entry angle, estimated atmospheric variations as of mid 1962, and parachute system weight. The primary objectives of this study were to determine if a parachute decelerator system

could provide a minimum of four minutes time of descent under the most severe entry conditions and to determine the minimum altitude at which deployment would take place if the first objective, i.e., four-minute time of descent, was achieved. It has been concluded that a three-stage parachute system with the first stage deployed at a maximum dynamic pressure of 500 psf and weighing approximately 17 pounds would provide a minimum-weight decelerator system. The weight of the entire recovery system, which includes the 17 pounds for parachutes and associated equipment, is estimated to be 28.2 pounds for a 200-pound entry vehicle. Author

N64-15593 Aerospace Corp., El Segundo, Calif.
THE INFLUENCE OF TESSERAL HARMONICS ON NEARLY CIRCULAR POLAR AND EQUATORIAL ORBITS
P. T. Guttman 4 Nov. 1963 109 p refs
(Contract AF 04(695)-269)
(SSD-TDR-63-284; TDR-269(4550-10)-4; AD-429318)

A study has been conducted to determine the effects of some of the tesseral harmonics of the earth's gravity potential on the motion of nearly circular, polar, and equatorial satellite orbits. Analytical expressions have been derived, and results are presented for the radial, in-track, cross-track, and nodal period perturbations resulting from the presence of the second sectorial ($J_2^{(2)}$) harmonic. The effects of some of the higher order tesseral harmonics on nearly circular polar orbits have been assessed by means of numerical (digital computer) investigations. The influence of tesseral harmonics on the special case of the 24-hour equatorial orbit have been determined analytically, and results are presented that illustrate the drifts from the nominal position that occur in this class of orbits as a result of the perturbative forces. Wherever possible, the analytical solutions have been compared with results obtained from numerical integration. Author

N64-15781* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
ON THE PRESENCE OF OXYGEN IN THE ATMOSPHERE OF VENUS
V. K. Prokofyev and N. N. Petrova 15 Jan. 1964 21 p refs
Transl. into ENGLISH from Izv. Krymsk. Astrofiz. Observ. (Moscow), v. 29, 1963 p 3–14
(NASA Contract NAS7-100)
(NASA CR-53061; JPLAI/Trans.-33) OTS: $2.60 ph, $0.83 mf

Spectra of reflected solar light from Venus in the region of the telluric oxygen α-band at a dispersion of 1A/mm were obtained with an echelle spectrograph (grating spectrograph) attached to the solar tower telescope. The photometric reduction of the plates showed an asymmetry in the lines of the telluric oxygen α-band. This asymmetry may be due to a faint oxygen-absorption band formed in the region above the cloud layer of the atmosphere of Venus. R.T.K.

N64-15793* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
SPACE PROGRAMS SUMMARY NO. 37-25, VOLUME VI FOR THE PERIOD 1 NOVEMBER-31 DECEMBER 1963. SPACE EXPLORATION PROGRAMS AND SPACE SCIENCES
31 Jan. 1964 65 p refs
(NASA Contract NAS7-100)
(NASA CR-53058; JPL-SPS-37-25, Vol. 6) OTS: $6.60 ph, $2.15 mf

The current status is presented of: (1) the lunar program covering the Ranger and Surveyor Projects; (2) the planetary–interplanetary program covering the Mariner Project; (3) the deep-space-instrumentation facility covering communications research and development; (4) the operational and test facilities for Ranger Block III, Ranger Mark IV, and Mariner C; (5) space-instruments development for Mariner C and Ranger Block III; and (6) space-instruments systems for Mariner C and Mariner II. I.v.L.

N64-15794* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
EARTH-VENUS TRAJECTORIES, 1970, VOLUME 5, PART A
V. C. Clarke, Jr., R. Y. Roth, W. E. Bollman, T. W. Hamilton, and C. G. Pfeiffer 16 Sep. 1963 790 p refs
(NASA Contract NAS7-100)
(NASA CR-53073; JPL-TM-33-99, Vol. 5, Pt. A) OTS: $31.00 ph, $23.90 mf

The results of machine computations of three-dimensional ballistic interplanetary trajectories are presented. The analytic model used to represent these trajectories is based upon two-body, inverse-square, force field mechanics. The trajectories are calculated in two distinct parts: (1) the heliocentric transfer ellipse, and (2) the launch-planet-centered escape trajectories. Following these trajectories, differential corrections or error coefficients and guidance and tracking parameters are given. R.T.K.

N64-15795* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
EARTH-VENUS TRAJECTORIES, 1970, VOLUME 5, PART C
V. C. Clarke, R. Y. Roth, W. E. Bollman, T. W. Hamilton, and C. G. Pfeiffer 15 Oct. 1963 790 p refs
(NASA Contract NAS7-100)
(NASA CR-53974; JPL TM-33-99; Vol. 5, Pt. C) OTS: $31.00 ph, $23.90 mf

This report presents the result of extensive machine computations of three-dimensional ballistic interplanetary trajectories. The analytical model used to represent these trajectories is based on the two-body, inverse square, force-field mechanics. Basically, the trajectories are calculated in two distinct parts: (1) the heliocentric transfer ellipse; and (2) the launch-planet-centered escape trajectories. Following these trajectory calculations, differential corrections or error coefficients and guidance and tracking parameters are given. This volume contains 9,120 trajectories for the year 1970. I.v.L.

N64-15813 Lockheed-California Co., Burbank
ASTRODYNAMIC CONSTANTS ANALYSIS Final Report
Mary P. Francis 31 Jul. 1963 241 p refs
(Contract AF 19(628)-1619)
(AFCRL-63-705; LR-17571; AD-430017)

A summary of current values of astrodynamic constants, including heliocentric, geocentric, selenocentric, and planetocentric constants is presented. Interrelationships between constants are given. An internally consistent but tentative set of recommended values is given. A discussion is made of the relative accuracies of determinations of the geocentric gravitational constant from radar and angular observations of the moon and from other sources. Author

N64-15863* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ORBITAL PARAMETERS FOR ARTIFICIAL EARTH SATELLITES UP TO 40,000 KM ALTITUDE
Walter H. Stafford, Sam H. Harlin, and Carmen R. Catalfamo 29 Aug. 1963 84 p refs
(NASA TM X-54563; MTP-P&VE-F-63-19) OTS: $7.60 ph, $2.72 mf

Data were generated to assist in the initial sizing of vehicles for lunar and interplanetary missions. Section A of the report is a series of graphs concerning circular orbits from 0- to 40,000-km altitude. Section B is a series of graphs for transfer from circular orbits of 0- to 400-km altitude to other circular orbits of altitudes up to 40,000-km altitude. The velocity required to enter a given transfer ellipse and also the velocity required to circularize at apogee of the transfer ellipse are given. Author

N64-15864* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

MOTION OF THE SUB-SATELLITE POINT FOR 24-HOUR ORBITS

Walter H. Stafford, Carmen R. Catalfamo, and Sam H. Harlin 22 Aug. 1963 50 p refs

(NASA TM X-54564; MTP-P&VE-F-63-13) OTS: $4.60 ph, $1.70 mf

The effects of small changes in eccentricity, inclination, and argument of perigee on the motion of the subsatellite point for 24-hour orbits were investigated. The eccentricity was varied from 0.0 to 0.1, inclination from 20° to 90°, and argument of perigee from 0° to 90°. Two additional values for the argument of perigees, 135° and 180°, were used in one case for comparison. The results show graphically the delta longitude and latitude of the subsatellite point. Author

N64-15879* General Dynamics/Astronautics, San Diego, Calif.

METHODOLOGY OF MISSION AND SYSTEMS SYNTHESIS OF MANNED PLANETARY FLIGHTS WITH PARTICULAR EMPHASIS ON VENUS AND MARS AS TARGET PLANETS

K. A. Ehricke 1 Jul. 1963 102 p

NASA Contract NAS8-5026)

(NASA CR-55409; AOK63-019) OTS: $9.10 ph, $3.26 mf

A description of a method for the parametric analysis of planetary round-trip missions using high-acceleration propulsion systems is presented. The method consists of two parts. The principal difference between these is that in the first part the flight mechanics is based on impulse and maneuvers, and the weight estimates are based on the use of the mass fraction x, defined as the sum of propellant weight and wet inert weight divided by the propellant weight. The second part is based on finite propulsion periods and on the use of scaling coefficients; in the first part, the latter were implicitly contained in the definition of the mass fraction. A number of equations and graphs are presented that are of practical value in applying the described methods. The graphs refer to Venus and Mars as target planets. R.T.K.

N64-15885* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

A DERIVATION OF THE THREE DIMENSIONAL THREE DEGREE OF FREEDOM RE-ENTRY EQUATIONS OF MOTION IN TERRESTRIAL NAVIGATIONAL COORDINATES WITH SUBSEQUENT RESOLUTION INTO INERTIAL PLATFORM COORDINATES

Carl L. Colwell 30 Aug. 1963 30 p refs

(NASA TM X-54561; MTP-ASTR-N-63-10) OTS: $2.60 ph, $1.10 mf

The three-dimensional three-degree-of-freedom reentry equations of motion and the input requirements for their solution on the IBM 7090 digital computer are derived. The material presented is the first formulation required to eventually achieve a hardware error-analysis capability for three-dimensional six-degree-of-freedom closed-loop reentry guidance and control. The presentation consists of the derivation of the three-dimensional three-degree-of-freedom reentry trajectory expressed in terms of terrestrial navigational coordinates. The derivation of the coordinate transformation equations required to express the solution of the above equations in terms of inertial platform coordinates is also presented. Author

N64-15891* General Mills Corp., Minneapolis, Minn. Electronics Div.

INVESTIGATION OF SPUTTERING EFFECTS ON THE MOON'S SURFACE Third Quarterly Status Report, 25 Oct. 1963-24 Jan. 1964

G. K. Wehner, D. L. Rosenberg, and C. E. KenKnight 12 Feb. 1964 21 p refs

(NASA Contract NASw-751; Proj. 89308)

(NASA CR-55720; Rept. 2527) OTS: $2.60 ph, $0.83 mf

Experiments to investigate the influence of bombardment of the lunar surface by the solar wind were continued. Darkening of basalt powder surfaces as a function of energy and duration of hydrogen ion bombardment has been determined. Reflection curves for complex solid mineral surfaces before and after bombardment have been measured. The hole-drilling method of determining sputtering yields has been extended to the oxides of Al, Ti, and Fe. Author

N64-15896* Texaco Experiment Inc., Richmond, Va.

A THEORETICAL STUDY OF THE PROPAGATION AND ATTENUATION OF ACOUSTIC WAVES IN THE LUNAR SURFACE Interim Report

R. L. Wolf and R. E. Canup 9 Feb. 1962 12 p

(NASA Contract NAS7-100)

(NASA CR-55413; EXP-387; TM-1325) OTS: $1.60 ph, $0.80 mf

Computations were made of the decrease in displacement of waves with frequencies from 25 to 3500 cps in passing through an attenuating medium. The usual attenuation equations were used with constants that have been determined by seismological experiments. Calculations were made at 2-ft intervals for 2 to 20 ft of wave travel. Author

N64-15907* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

THE DRIFT OF A 24-HOUR EQUATORIAL SATELLITE DUE TO AN EARTH GRAVITY FIELD THROUGH 4TH ORDER

C. A. Wagner Washington, NASA, Feb. 1964 37 p refs

(NASA TN D-2103) OTS: $1.00

The three, coupled, second-order linear differential equations of initial drift from a 24-hour, equatorial, circular reference orbit are presented. This linear system is analyzed for stable regions in the field within which drift motion is self-limiting. A somewhat simplified form of the linear equations is integrated to give a general solution, that defines the mean daily motion after injection to a high degree of accuracy. Author

N64-15969* National Aeronautics and Space Administration, Washington, D.C.

INITIAL CONCEPT OF LUNAR EXPLORATION SYSTEMS FOR APOLLO. VOLUME V— SUMMARY DIGEST

Mar. 1964 34 p Work performed under contract by Boeing Co.

(NASA Contract NASw-792)

(NASA CR-39) OTS: $1.00

The objective of the study of an Initial Concept of Lunar Exploration Systems for Apollo was to develop the conceptual design of a lunar-exploration support system within the following general criteria: (1) utilization of a modular approach

to all subsystems; (2) flexibility in scope (2 to 18 men), duration (3 months to 2 or more years), and type of mission activity; (3) maximum lunar-logistic-vehicle payload weight of 25,000 earth pounds; and (4) feasibility of development for the 1970 to 1974 time period. The basic modular concept, together with the stated ground rules and implied mission objectives, was the starting point for systems analyses aimed at guiding the subsystems investigations and contributing to the overall concept definition. Maximum use of Apollo system elements was considered. As the subsystem aspects of the base concept were developed, meaningful concepts for base installation, operation, maintenance, and logistics support were outlined. This included considerations of base arrangements, packaging of base modules into lunar logistics vehicle (LLV) payloads, and resolution of the interface relationships between subsystems, and modules of the base complex.
Author

N64-16068* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
FEASIBILITY OF INTERSTELLAR TRAVEL
Dwain F. Spencer and Leonard D. Jaffe [1963] 25 p refs Presented at a GE Co.-AFOSR Symp.
(NASA CR-53072; JPL-TR-32-233) OTS: $2.60 ph, $0.95 mf

This paper shows that nuclear fission or fusion rockets can theoretically perform interstellar missions with reasonable flight times. The problem of utilizing the full potential of fission or fusion nuclear reactions in a rocket engine is more difficult. Some of the requirements of a fusion-propelled vehicle to perform an interstellar probe mission are discussed. Author

N64-16072 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
SATELLITES, ATMOSPHERE, AND ELECTRONS
Yu. Gal'perin and T. Mulyarchik 29 Oct. 1962 9 p Transl. into ENGLISH from Pravda (Moscow), 26 Sep. 1962 p 6
(FTD-TT-62-1547/1+4; AD-292198)

Geophysical and astronomical contributions of Russian satellites are reviewed. The orbits of Cosmos III and Cosmos V have made possible the determination of how the intensity of corpuscular radiation above a given geographic region changes in the whole range of heights from apogee to perigee. The lengthy existence of these satellites has enabled the measurement of the average density of the upper atmosphere and its changes, dependent on a 24-hour period and on the latitude, at the altitude of perigee (about 200 km) with greater accuracy than that obtained previously. Electron pickups by Cosmos V showed that at a great height the weak corpuscular radiation first discovered by Cosmos III was present not only a high but also at middle latitudes. The remaining two electron pickups permitted the study of the distribution of the electron vectors in the earth's magnetic field. Knowing this distribution and the laws of motion of charged particles in a magnetic field makes it possible to determine the intensity of corpuscular radiation not only at the heights where the satellite is located but also at other points along the same line of magnetic force. Trapped particles are also discussed. I.v.L.

30 SPACE VEHICLES

Includes launch vehicle-spacecraft combinations; missile systems; operating problems; safety devices; and stability and control. *For boosters and launch vehicles see*: 31 Space Vehicles (Launch Vehicles). *For related information see*: 04 Aircraft; 08 Communications; and 22 Navigation and Guidance.

N64-15193 Aeronca Mfg. Corp., Middletown, Ohio
FACTORS AFFECTING THE PRELIMINARY DESIGN OF ORBITING RE-ENTRY VEHICLES. VOLUME I: CONSIDERATION OF AERODYNAMIC FACTORS A State of the Art Study
Charles Giemza, William Niehaus, and Wendell Voss [1963] 73 p refs
(ER-673, Vol. 1)

The significant aspects of design, analysis, and utility of reentry vehicles are discussed, and the following are presented: (1) recent developments in composite heat shields—the "thermantic panel," (2) proposed advances in heat shield technology, (3) adaptation of drag devices and control surfaces that would optimize lifting vehicle performance, (4) proposed lift vehicle configurations, (5) structural and heat shield subassemblies, (6) the environment, (7) applicable stress and thermal analysis, and (8) test methods and devices and the correlation of test data to design. P.V.E.

N64-15194 Aeronca Mfg. Corp., Middletown, Ohio
FACTORS AFFECTING THE PRELIMINARY DESIGN OF ORBITING RE-ENTRY VEHICLES. VOLUME 2: ENVIRONMENTAL FACTORS A State of the Art Study
Charles Giemza, William Niehaus, and Wendell Voss [1963] 78 p refs
(ER-673, Vol. 2)

This report identifies and qualifies the factors that comprise the environment relating to ballistic and lift vehicles for circular and supercircular missions during ascent, orbit, and reentry. The environmental input is related to specific design areas affected, but their critical effect on design depends on specific mission objectives and performance requirements.
R.L.K.

N64-15257 General Electric Co., Philadelphia, Pa. Missile and Space Div.
A SIMULATION OF MULTIPLE RE-ENTRY VEHICLE DELIVERY
H. C. Sebring and S. Matlin *In* AF Systems Command Trans. of the 8th Symp. on Ballistic Missile and Space Technol., Vol. 2 [1963] p 123–157 refs (See N64-15251 07-01)

A Monte Carlo simulation of multiple reentry vehicle delivery is presented, followed by applications and results. The model is unique in that it has six options, which permit a variety of inquiries with economy in cost and time. Applications reveal advantages in using multiple reentry vehicles (R/V's) in comparison with a larger single R/V. Optimum aimpoint patterning relative to R/V survival probability is discussed. Mission-effectiveness and systems-error analyses are made, and translations to R/V design criteria are indicated. Author

N64-15263 Space-General Corp., El Monte, Calif.
PARAGLIDER BOOSTER RECOVERY SYSTEMS
J. E. Crawford and J. D. Mc Nerney *In* AF Systems Command Trans. of the 8th Symp. on Ballistic Missile and Space Technol. Vol. 2 [1963] p 293–306 refs (See N64-15251 07-01)

The operational requirements for recovery systems are discussed, and the aerothermodynamic and structural characteristics for a family of paraglider recovery systems are presented. Reentry equilibrium stagnation temperatures are typically below 500° F, permitting the use of low-cost, low-temperature materials of construction. Inflatable and erectable configurations, as well as various control schemes, are also discussed. Weight estimates for the complete recovery system range from 5% to 12% of the payload weight, as a function of burnout velocity and reentry heating and pullout accelerations.
Author

N64-15535* Itek Corp., Palo Alto, Calif. Vidya Div.
STUDY TO EVALUATE EXISTING RE-ENTRY AND OTHER FLIGHT TEST DATA Second Quarterly Progress Report, June 12, 1963-September 13, 1963
W. J. Fleming, Jr. [1963] 41 p refs
(NASA Contract NAS7-216)
(NASA CR-55580) OTS: $4.60 ph, $1.43 mf

This report gives the present status of data collection, summarizes the results obtained to date in the supporting studies of data reduction and heat-transfer prediction methods, and records the man-hour and dollar-expenditure histories through the end of the reporting period. E.W.

N64-15629 Applied Physics Lab., Johns Hopkins U., Silver Spring, Md.
SOME FACTORS INFLUENCING THE AERODYNAMIC STABILITY OF HYPERSONIC INTERCEPTOR TYPE MISSILE CONFIGURATIONS
H. H. Hart and J. C. Hagen *In* Bur. of Naval Weapons Proc. of the 6th U.S. Navy Symp. on Aeroballistics [1963] 19 p refs (See N64-15626 07-11)
(Sponsored by BUWeps)

The stability characteristics of a typical missile configuration were studied at Mach 8. The missile had a body consisting of a slightly blunted 15° half-angle cone-cylinder of fineness ratio 10. Mounted on the body were 4 cruciform low-aspect-ratio "wings" with a thickness of 80% of span and rounded leading and outboard edges that extended from the shoulder to a point just ahead of the leading edges of four 55° swept delta tail panels. The tail panels had a 2 1/2° single-wedge cross section. For the configuration studied, the data indicated the existence of two flow regimes: (1) At low angles-of-attack, the flow is dominated by the nose shock wave, with shock-expansion-type theories applicable. (2) At high angles-of-attack, the flow is of the crossflow type, wherein the nose does not affect the flow over the afterbody, and Newtonian-type theories are applicable. Somewhere between 12° and 16° angle-of-attack, there is a short transition regime from one type of flow to the other. It is noted that the configuration stability can change markedly from one flow regime to the other. P.V.E.

N64-15630 Aberdeen Proving Ground, Md. Ballistic Research Lab.
NONLINEAR MOTION OF SYMMETRIC BALLISTIC MISSILES
Charles H. Murphy *In* Bur. of Naval Weapons Proc. of the 6th U.S. Navy Symp. on Aeroballistics [1963] 7 p refs (See N64-15626 07-11)

The quasi-linear analysis and associated amplitude planes can successfully predict missile motion caused by a linear static moment and nonlinear damping moments. This success is illustrated by the analyses of Weapon A motion and the observed limit cycle motion of low-fineness-ratio reentry configurations. This quasi-linear analysis is then extended to include the effects of a nonlinear static moment and air density variations associated with the flight of a missile leaving or entering the earth's atmosphere. A more exact perturbation method can be applied to the case of a cubic static moment. This method makes use of two quasi-constants of the motion-energy and angular momentum and is used to construct generalized amplitude planes for a nonspinning missile with cubic static and damping moments. The predictions of this more exact method are then compared with those of the quasi-linear method, and it is found that the quasi-linear method is surprisingly good. Author

N64-15631 Avco Corp., Wilmington, Mass. Research and Development Div.
AERODYNAMIC PHENOMENA ASSOCIATED WITH ADVANCED RE-ENTRY SYSTEMS
I. Sacks and E. E. H. Schurmann *In* Bur. of Naval Weapons Proc. of the 6th U.S. Navy Symp. on Aeroballistics [1963] 32 p refs (See N64-15626 07-11)

Wall or surface temperature has been shown to significantly affect vehicle stability on those bodies that characteristically experience a separation of flow, e.g., cone-cylinder-flare configurations. The problem that derives from injection into the boundary layer, comes about from the increased use of ablation-type thermal protection systems on high-performance reentry vehicles. It is shown that substantial changes in vehicle stability can result under such conditions. This paper presents the results of analytical studies and wind tunnel tests in which wall temperature and mass injection into the boundary layer have been factored in and controlled. Comparisons are made between analytical and test results to explain the reasons for the changes observed in the flow pattern and in the vehicle stability. Implications to flight are discussed. Author

N64-15774 Avco, Corp., Wilmington, Mass. Research and Advanced Development Div.
FABRICATION OF NOSECAPS FOR SCOUT SUPERCIRCULAR REENTRY PROGRAM Final Report
M. A. Guidi 14 Nov. 1963 38 p
(Contract M3J3XA-934009)
(RAD-TR-63-44)

The primary goal in the design of the nosecaps was the incorporation of the current Apollo heat shield material, Avcoat 5026-39 H/C/G, in the instrumented nose region of the ablator. Since final specifications for the Apollo heat shield were not released in most cases, and process development was still in progress, it was agreed that the best current practice would be employed in all areas of the fabrication and that the actual procedures of fabrication would be detailed in a fabrication report. This report gives this information, as well as data on sensor locations and other pertinent data for each nosecap. Author

N64-15869* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
AN EXAMPLE OF A REUSABLE EARTH-LUNAR TRANSPORTATION SYSTEM
H. H. Koelle and C. H. Rutland Jun. 1963 22 p refs Paper presented to the AIAA Summer Meeting, Los Angeles
(NASA TM X-51436) OTS: $2.60 ph, $0.86 mf

This paper discusses a lunar transportation system utilizing reusable vehicles throughout the mission. The vehicle concepts discussed are based on feasibility and conceptual design studies performed by industry for the Future Projects Office, George C. Marshall Space Flight Center. Author

N64-15972* National Aeronautics and Space Administration, Washington, D.C.
FIELD WIND WEIGHTING AND IMPACT PREDICTION FOR UNGUIDED ROCKETS
Keith E. Hennigh (N. Mex. State U.) Mar. 1964 26 p refs Work performed under contract for Goddard Space Flight Center
(NASA Contract NAS5-1032)
(NASA TN D-2142) OTS: $0.75

The mathematics for predicting impacts of unguided sounding rockets is presented. Wind measurements from several sources are combined with rocket wind response functions into

equations suitable for digital computer application. This method has been used on four missile ranges, each utilizing a different type of digital computer. Author

31 SPACE VEHICLES (LAUNCH VEHICLES)

Includes boosters; clustered rockets; and multistage rockets. *For propulsion engines see*: 27 Propulsion. *For manned space capsules, satellites, and sounding rockets and space probes see*: 32 Space Vehicles (Spacecraft). *For launch vehicle-spacecraft combinations see*: 30 Space Vehicles. *For related information see*: 04 Aircraft; 08 Communications; and 22 Navigation and Guidance.

N64-15918 RAND Corp., Santa Monica, Calif.
A COST ANALYSIS OF LARGE BOOSTER SYSTEMS FOR PLANETARY EXPLORATION
H. G. Campbell Aug. 1963 34 p Presented at the 12th Rocket and Space Flight Conf. of the Ger. Rocket Soc., Hamburg, Sep. 1963
(P-2769)

The systems considered require differing degrees of technological advancement, ranging from a two-stage Nova system, which is basically a scaled-up version of the Saturn C-5, to fully recoverable single-stage-to-orbit vehicles employing high-chamber-pressure liquid oxygen–liquid hydrogen engines. The recovery concepts include different methods of heat protection on reentry (ablation, liquid-hydrogen cooling, and radiation cooling), as well as different modes of control at touchdown (parachute-retrorocket deceleration to essentially zero speed at impact, direct impact into the water at speeds up to 600 fps, and an inflatable structure that provides buoyancy at altitudes up to 2000 ft). The systems are described, and a method for estimating the costs of large launch vehicles is discussed. Author

32 SPACE VEHICLES (SPACECRAFT)

Includes manned space capsules; satellites; and sounding rockets and space probes. *For boosters and launch vehicles see*: 31 Space Vehicles (Launch Vehicles). *For launch vehicle-spacecraft combinations see*: 30 Space Vehicles. *For related information see*: 04 Aircraft; 08 Communications; and 22 Navigation and Guidance.

N64-15220* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ENVIRONMENTAL TEST PROGRAM FOR ARIEL I
Warner H. Hord, Jr. Washington, NASA, Feb. 1964 69 p
(NASA TN D-2099) OTS: $1.75

The program consisted of design qualification tests for the prototype spacecraft and acceptance tests for the two flight spacecraft. The spacecraft separation system and the flight vibration experiment also received design qualification and flight acceptance tests. Several failures in the prototype spacecraft occurred during the test program and resulted in various modifications and replacements. Author

N64-15266 General Dynamics Corp., Pomona, Calif.
MANNED ANTI-SATELLITE SYSTEM
E. E. Honeywell *In* AF Systems Command Trans. of the 8th Symp. on Ballistic Missile and Space Technol., Vol. 2 [1963] p 369–409 refs (See N64-15251 07-01)

A conceptual design of a manned orbital inspection system is presented. The concept provides for close inspection of the target satellite while still alowing the crew to remain a relatively safe distance from the potentially hostile satellite. In addition, the concept includes a means of destroying the target satellite if it is determined to be hostile. The command module of the system is a reentry body that is capable of returning the crew to a selected landing site and landing in the manner of a high-performance airplane. The Titan III booster is considered as the launch vehicle in the concept. Author

N64-15281 Georgetown U., Washington, D.C.
SATELLITE WAKES
W. J. Thaler *In its* Recent Advances in Astro-Geophysics [1961] p 29–38 (See N64-15276 07-01)

A satellite wake is defined as the perturbation produced in the vicinity of the satellite in the ionosphere or in the interplanetary gas. The topics discussed are perturbations of particle concentration and the electric field, and experimental data on the scattering of radio waves by satellite trails. R.T.K.

N64-15532* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SATELLITE SITUATION REPORT, VOLUME 3– NUMBER 25
31 Dec. 1963 11 p
(NASA TM X-54539; NASA X-533-63-1) OTS: $1.60 ph, $0.80 mf

Included in this report are launch date, code name, source, nodal period, inclination, apogee, perigee, and transmitting frequency for all objects in orbit that were launched during the period February 1, 1958, to December 1, 1963. E.W.

N64-15554* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE ORBITING GEOPHYSICAL OBSERVATORIES
George H. Ludwig Repr. from Space Sci. Rev. (Dordrecht), v. 2, 1963 p 175–218 refs
(NASA RP-130)

The Orbiting Geophysical Observatories and the supporting ground equipment are designed to conduct large numbers of diverse experiments. Configured to meet scientific requirements, the observatories include six booms to support detectors away from disturbances generated in the main body. Five degrees of freedom allow the orientation of experiments relative to three references—the earth, the sun, and the orbital plane. Power, thermal control, and data-handling subsystems provide for the proper operation of the experiments and telemetry of the data. Ground stations receive these data, which are then processed into a form suitable for use by the experimenters. The systems have been designed to make available standard spacecraft and support equipment that can be used repeatedly to carry large numbers of easily integrated experiments in a wide variety of orbits. Author

N64-15780* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
MARINER B TELECOMMUNICATION SYSTEM RELIABILITY STUDY

Man K. Tam 15 Aug. 1963 129 p refs
(NASA Contract NAS7-100)
(NASA CR-53056; JPL-TM-33-146) OTS: $10.10 ph, $4.07 mf

Functional reliability equations of the Mariner B spacecraft telecommunication system are derived by using event algebra and a reliability model constructed under considerations of partial successes. These equations are enumerated and are given in terms of other dependents within the spacecraft. Numerical values for the functional reliabilities are obtained on a parts-count basis. Three-dimensional graphical displays are constructed for each of the functional equations. Reliability improvement in general is considered from the standpoint of functional blocks, as well as on the basis of individual circuitry. A comprehensive comparison between the results of the Mariner A and the Mariner B reliability studies is presented. Author

N64-15791* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
SPACE PROGRAMS SUMMARY NO. 37-24, VOLUME VI FOR THE PERIOD 1 SEPTEMBER-30 NOVEMBER 1963. SPACE EXPLORATION PROGRAMS AND SPACE SCIENCES
31 Dec. 1963 91 p refs
(NASA Contract NAS7-100)
(NASA CR-53069; JPL-SPS-37-24, Vol. 6) OTS: $8.60 ph, $2.93 mf

The following topics are discussed: (1) lunar program—Ranger Project and Surveyor Project; (2) the planetary–interplanetary program—Mariner C Project and Voyager Project; (3) the deep space instrumentation facility—communications research and development; (4) operational and test facilities—environmental test laboratory and operational support equipment; and (5) space sciences—space instruments development and space instruments systems. R.T.K.

N64-15859* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SYSTEM PERFORMANCE OF METEOROLOGICAL SATELLITES
Rudolf A. Stampfl Aug. 1963 23 p
(NASA-TM-X-54565; X-650-63-166) OTS: $2.60 ph, $0.89 mf

The system performance of the seven TIROS satellites that have been launched and operated are described. A discussion is included of TIROS tracking, television, and infrared radiometer subsystems. R.T.K.

N64-15860* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SATELLITE SITUATION REPORT, VOLUME 3, NO. 10
15 May 1963 8 p
(NASA TM X 54579; X-533-63-1) OTS: $1.10 ph, $0.80 mf

This report reflects data computed and compiled by the Goddard Space Flight Center, NORAD, and the Smithsonian Astrophysical Observatory as of 1430Z on May 15, 1963. The data concern objects in orbit that were launched between 1958 and 1963. Also, data on three decayed Russian objects are presented. I.v.L.

N64-15964* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
THE MARINER 2 INFRARED RADIOMETER EXPERIMENT
S. C. Chase, L. D. Kaplan, and G. Neugebauer Repr. from J. Geophys.
(NASA Contract NAS7-100)
(NASA CR-53071; JPL-TR-32-484)

Measurements of the 8.4μ and 10.4μ radiation temperature of small regions of Venus were made using an infrared radiometer on Mariner 2. The radiation temperatures agree with broadband (8μ to 13μ) earth-based measurements, the light- and dark-side temperatures are equal, and there is definite limb darkening. The data are consistent with equal radiation temperatures at 8.4μ and 10.4μ, which is interpreted as indicating that the emission is from a cloud structure. No breaks in the clouds were observed. A description of the radiometer instrumentation and operation is given. Author

N64-16026* National Aeronautics and Space Administration, Washington, D.C.
SPACE SCIENCES AND APPLICATIONS PROGRAMS: Report to the Space Sciences Board
H. E. Newell Dec. 1963 112 p
(NASA TM X-54602) OTS: $9.60 ph, $3.56 mf

Subjects discussed in this report include: (1) Past Accomplishments; (2) Planned Flight Schedule; (3) Instruments and Investigations for Forthcoming Missions; (4) Manned Space Science; (5) University Programs; (6) Satellite Applications; and (7) Summary of NASA Launch Vehicles. P.V.E.

N64-16029* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SATELLITE SITUATION REPORT, VOL. 4, NO. 3
15 Feb. 1964 11 p
(NASA TM X-54589; X-533-63-1) OTS: $1.16 ph, $0.80 mf

This report reflects data computed and compiled as of 1200Z on February 15, 1964. Included are the names of the objects, the code names, the source of launch, the date of launch, the nodal periods, the inclinations, the apogees and perigees, and the transmitting frequencies. C.L.W.

N64-16030* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SATELLITE SITUATION REPORT, VOLUME 4, NO. 2
31 Jan. 1964 12 p
(NASA TM X-54595; X-533-63-1) OTS: $1.60 ph, $0.80 mf

This report reflects data computed and compiled by the Goddard Space Flight Center, NORAD, and by the Smithsonian Astrophysical Observatory as of 1200Z on January 31, 1964. Author

33 STRESSES AND LOADS

Includes fatigue; vibration; flutter; and structural tests. *For thermal stress see*: 13 Heat Transfer and Thermodynamics. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 34 Structural Design.

N64-15021 Deutsche Forschungsanstalt für Luft- und Raumfahrt, Brunswick (W. Germany) Institut für Flugzeugbau
THE EXPERIMENTAL DETERMINATION OF THE BUCKLING LOADS OF LONGITUDINALLY PRESSED THIN-WALLED CIRCULAR CYLINDRICAL SHELLS [DIE EXPERIMENTELLE ERMITTLUNG DER BEULLASTEN VON LANGSGEDRUCKTEN DUNNWANDIGEN KREISZYLINDERSCHALEN]
O. Heise [1963] 31 p refs In GERMAN
(DFL-214)

Thin-walled circular cylinders, made of Mylar foil, were axially loaded by means of eccentric acting single forces. The buckling load was measured as a function of the eccentricity of the points of application of the loads. The buckling load for a concentric-acting load can be derived by extrapolation. The extrapolated longitudinal load was approximately 84% of that derived from the classical theory of buckling. The effect of boundary conditions, for radial deformation, on the buckling load is discussed. The construction of the test cylinder and a method for testing the quality of the test specimen are discussed. Trans. by I.v.L.

N64-15025 Deutsche Versuchsanstalt für Luft- und Raumfahrt, Mülheim an der Ruhr (W. Germany)
CONCERNING THE RELATIONSHIPS BETWEEN THE LIFE OF STRUCTURAL ELEMENTS UNDER IRREGULARLY FLUCTUATING AND UNDER ORDERED LOAD EFFECTS [UBER DIE BEZIEHUNGEN ZWISCHEN DER LEBENSDAUER VON BAUTEILEN BEI UNREGELMASSIG SCHWANKENDEN UND BEI GEORDNETEN BELASTUNGSFOLGEN]
J. Kowalewski (Ph.D. Thesis—Tech. Hochschule Aachen) Sep. 1963 135 p In GERMAN
(DVL-249; Thesis 82) Available from Vereinigte Universitäts- u. Fachbuchhandlungen, R.-Wagner-Str. 1, Cologne, W. Germany

The loading of aricraft components according to Böen is discussed, fatigue investigations on notched flexible bars under irregularly fluctuating loads and under ordered loads are described, and the statistical characteristics of the probability process are given. A simple probability density of the maxima of the probability function and of the critical moments is given for the two-dimensional probability density of the difference and the sum of the values of a probability-function maximum and minimum, which are separated by t sec. It is shown that all moments of this distribution can be exactly given. It is also shown that the first term of a Taylor expansion of the moments, according to time, contains only a contiguous maxima and minima. Based on the characteristics of the first term, an approximation is derived for the difference and the sum of the values of a maximum and an ensuing minimum. The smaller the difference is between the quantity of maxima and the quantity of the critical moments, the more accurate the approximation. I.v.L.

N64-15053 Forest Products Lab., Madison, Wis.
CLASSICAL BUCKLING OF CYLINDERS OF SANDWICH CONSTRUCTION IN AXIAL COMPRESSION, ORTHOTROPIC CORES
John J. Zahn and Edward W. Kuenzi Nov. 1963 21 p refs (Contract AF 33(657)-63-358; BuWeps Order 19-64-8004-WEPS)
(FPL-018; Its ANC-23, Item 59-3; AD-429302)

Classical small deflection theory is used to derive buckling coefficients for cylinders of sandwich construction under axial compression. The core is assumed to be orthotropic, but the results do not differ much from isotropic core, unless the core shear modulus is much smaller circumferentially than axially. The buckling coefficients for isotropic core and orthotropic core stiffened circumferentially are the same and are presented in a simple formula. Author

N64-15056 North American Aviation, Inc., Columbus, Ohio
HARDENED GROUND RADOMES FOR SYSTEM SURVIVAL Final Report, Jan. 1963-Oct. 1963
G. J. Cook Griffiss AFB, N.Y., Rome Air Develop. Center, Dec. 1963 83 p refs
(Contract AF 30(602)-2923)
(NA63H1035; RADC-TDR-63-487; AD-428989)

This investigation consists of determining the dynamic response of a thin, uniform-thickness, truncated spherical shell to air-blast induced shock loads. The response analysis includes a failure criterion for determining the vulnerability of this type of structure to nuclear blasts. The structural dynamic characteristics of the radome were represented by the normal mode approach. The mathematical representation of the blast-induced pressure loading was based on published experimental data. A failure criterion based on strain energy considerations is suggested, which, when applied to the dynamic response, is indicative of structural failure. Solutions to this mathematical model were obtained from an operational analog computer. Author

N64-15108 Naval Ordnance Test Station, China Lake, Calif.
ELASTIC AND PLASTIC BEHAVIOR IN THE FINITE DEFORMATION OF METALS BY IMPACT AND EXPLOSIVE LOADING
Marvin E. Backman In ONR Solution to Navy Probl. through Advanced Technol. [1963] p 98–116 refs (See N64-15101 07-01) OTS: $5.00

The following problems are considered: (1) high strain rates—the modification of conventional concepts of plasticity and elasticity for the description of material behavior under very rapid development of stresses and strains; (2) finite deformation—the strains on a body that result from elastic and plastic contributions; (3) stress-strain relations for finite deformations; and (4) stress-strain relations for an isotropic solid. R.T.K.

N64-15118 Naval Research Lab., Washington, D.C.
SOURCES OF STRENGTH AND WEAKNESS IN GLASS REINFORCED PLASTIC STRUCTURES
G. R. Irwin and J. A. Kies In ONR Solution to Navy Probl. through Advanced Technol. [1963] p 263–285 refs (See N64-15101 07-01) OTS: $5.00

The strength and weakness factors of glass-reinforced plastic chambers subjected to external pressure were studied. Interlayer debonding weakened the structure by parallel kinking of the glass fibers along a line and in a direction that allowed greatest local relief from compressive stress in the layer. Failure also occurred when the glass reinforcement was in the form of square-weave glass cloth, and the initial kinking of the glass threads was due to the square-weave cloth construction. R.T.K.

N64-15172* General Electric Co., Philadelphia, Pa. Space Sciences Lab.
THE ELASTIC MODULI OF FIBER-REINFORCED MATERIALS
Zvi Hashin (Pa. U.) and B. Walter Rosen Repr. from. Trans. Am. Soc. Mech. Engrs. J. Appl. Mech., 1963 p 1–10 refs Presented at the Winter Annual Meeting of the ASME, Philadelphia, Nov. 17–22, 1963
(NASA Contract NASw-470; Contract NOw-61-0613-d)
(ASME Paper 63-WA-175)

Bounds and expressions for the effective elastic moduli of materials reinforced by parallel hollow circular fibers have been derived by a variational method. Exact results have been obtained for hexagonal arrays of identical fibers and approximate results for random array of fibers that may have unequal cross sections. Typical numerical results have been obtained for technically important elastic moduli. Author

N64-15238* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

FATIGUE IN ROLLING-ELEMENT BEARINGS

William J. Anderson *In its* Advanced Bearing Technol. 1964 p 371–450 refs (See N64-15226 07-01) GPO: $1.75

The Lundberg–Palmgren theory and formulas for calculating the specific dynamic capacity of rolling bearings are discussed. Taken into consideration are the many applications in which rolling bearings are required to operate under extreme conditions of speed and temperature with a variety of lubricants and lubrication techniques. In order to design bearing systems to meet the requirements of these operating conditions, the effects of bearing-material lubricants, speed, and temperature on fatigue life and load capacity have been investigated. Among the processing variables discussed are material composition, melting technique, hardness, fiber orientation, and contact angle. The operating variables discussed are load, speed, lubricant type, lubricant viscosity, and temperature. C.L.W.

N64-15405* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

THE INFLUENCE OF PREBUCKLING DEFORMATIONS AND STRESSES ON THE BUCKLING OF PERFECT CYLINDERS

Manuel Stein Washington, NASA, Feb. 1964 22 p refs (NASA TR-R-190) OTS: $0.50

Large-deflection theory is used to compute buckling loads of simply supported, initially perfect cylinders under axial compression, external pressure, and combinations of axial compression and internal or external pressure. Important results are obtained by taking into account prebuckling deformations and stresses induced by edge support. For example, the presence of these deformations and stresses can reduce the axial-compression buckling load of an unpressurized perfect cylinder to 50 percent of the classical value. Author

N64-15418 Royal Netherlands Aircraft Factories Fokker, Amsterdam

STRENGTH OF PLASTIC SANDWICH CONSTRUCTION

M. P. Nieuwenhulzen [1963] 38 p refs Presented at the Symp. of Sandwich Construct., London, 28 Nov. 1963

Some problems concerning the bending and buckling of sandwich constructions have been considered. Criteria governing the optimum sandwich design from the point of view of weight have been derived. Comparison between sandwich structures with high-strength aluminum-alloy and glass-reinforced faces showed that, for bending, the latter faces can be competitive. The low modulus of elasticity of glass-reinforced plastic will always be detrimental for the buckling load. In this report a method is given for estimating the maximum allowable axial load on a panel in cases where lateral loads are also acting. The analysis of the influence of coverwaviness or eccentricities showed that a significant decrease of the allowable axial loads must be excepted in cases where the covers are not completely straight. Author

N64-15537* Alabama U. Research Inst., Huntsville

THEORETICAL ANALYSIS OF THE STATIC GENERAL INSTABILITY OF AN ORTHOTROPIC CIRCULAR CYLINDER SUBJECTED TO AN AXIAL LOAD, END MOMENT AND UNIFORM RADIAL PRESSURE

William S. Viall and Carl C. Steyer Jan. 1964 47 p refs (NASA Grant NsG-381; NASA Contract NAS8-5168) (NASA CR-55703; UARI-11) OTS: $4.60 ph, $1.61 mf

The general instability differential equation of equilibrium for the cylindrical shell is of Donnell type, and is obtained by the application of variational methods to the expression for total change in energy during buckling. The Ritz method is used for this investigation, and the results are as accurate as the assumed deflection expression. The analysis has been programed, and the program has been run with arbitrary data. The results obtained with the arbitrary data could be only visually checked, and were within the range of expected results. E.W.

N64-15568 Naval Air Engineering Center, Philadelphia, Pa. Aeronautical Structures Lab.

VIBRATION INVESTIGATION OF A HEATED STRUCTURE. A COMPARISON OF METHODS

C. R. Nelson 18 Dec. 1963 44 p refs (NAEC-ASL-1068; AD-429162)

A transient excitation and wave analysis technique was developed for the experimental determination of the change in vibratory modes and frequencies of aerodynamic structures while undergoing transient heating. This report presents the results of a comparable investigation made using a resonance-following system. The room temperature modal shapes and frequencies for frequencies between 50 and 500 cps and the change in frequency for the first mode, were confirmed during transient heating to a maximum temperature of 500° F and with heating rates up to 50° F/sec. The heater design limited the application of the resonance-following system for the second and higher modes. Author

N64-15572 General Dynamics, Fort Worth, Tex.

FUSELAGE – TORSIONAL TEST OF ALUMINUM ALLOY COQUE CYLINDERS

J. May 15 Jan. 1964 18 p (Contract AF 33(657)-11214) (FTDM-2879; AD-429)

Tests were conducted to determine the torsional buckling strength for thin-walled monocoque cylinders of varying skin gages at a temperature 260° F. Test results are given; strain-gage data are presented; and tensile coupon data are recorded. Heat-rise rates up to 10.3° F/sec were measured, and results shown no detrimental effect on test specimens. All test specimens failed by shear buckling with 45-degree shear wrinkles developing in the skin over the 20-inch day. C.L.W.

N64-15668* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

ANALYSIS OF ELASTIC-PLASTIC SHELLS OF REVOLUTION CONTAINING DISCONTINUITIES

David A. Spera Repr. from AIAA Journal, v. 1, no. 11, Nov. 1963 p 2583–2589 refs Presented at the AIAA Launch and Space Vehicle Shell Structure Conf., Palm Springs, Calif., Apr. 1–3, 1963 (NASA RP-131)

The common junction of three dissimilar general shells of revolution is analyzed. Axisymmetric loading may be in the form of surface forces, concentrated forces and moments at the junction, and arbitrary thermal gradients. Basic differential equations available for elastic shells are extended for application in the elastic–plastic regime. The von Mises–Hencky yield criterion, deformation theory of plasticity, and successive approximations are used to determine plastic strains. Postyield material behavior is arbitrary. Linearized finite-difference equations are solved directly using coefficient matrices that incorporate conditions of equilibrium and compatibility at the junction discontinuity. The solution to a sample problem is given. Author

N64-15787* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

DYNAMIC ANALYSIS OF STRUCTURAL SYSTEMS BY COMPONENT MODE SYNTHESIS

Walter C. Hurty 15 Jan. 1964 45 p refs

(NASA Contract NAS7-100)

(NASA CR-53057; JPL-TR-32-530) OTS: $4.60 ph, $1.55 mf

A method of analysis is developed for treating structural systems by a synthesis of the properties of the system components. The method is developed to deal primarily with dynamic loads and responses, but it is also suitable for treating the static case. Displacement, velocity, and acceleration responses resulting from the application of forces with arbitrary time dependence may be determined. Internal forces in the connections among the components may be found, so that each component may be isolated from the system and analyzed in detail. Lagrange equations are used to generate the equations of motion, which are expressed and manipulated in matrix form. As presented in this report, the method is restricted to systems with linear force-deflection and force-velocity properties. Author

N64-15820 Naval Ordnance Lab., White Oak, Md.

STRESS-WAVE PROPAGATION IN ALUMINUM

R. H. Waser, J. L. Rand, and J. M. Marshall Mar. 1964 29 p refs

(NOLTR-63-141; Ballistics Res. Rept.-107; AD-429735)

The one-dimensional theory of stress-wave propagation has been found to adequately represent a three-dimensional experimental situation in both the elastic and plastic regimes. An air gun was used to accelerate a rod and impact it against a stationary test rod to produce a force pulse. The strain resulting from this pulse was recorded at various positions along the test rod. The deviation between the theoretical and experimental values of maximum stress was less than 11.5 percent. Author

N64-15849 Thiokol Chemical Corp., Brigham City, Utah Wasatch Div.

MISSILE MOTOR CASES

A. B. Smith [1962] 33 p refs

Results are given for the evaluation of present D6AC motor cases and three candidate materials—titanium, 301 stainless steel, and textured titanium. The present D6AC material was extensively evaluated by hydrobursting pressure vessels and by standard laboratory tests. Each vessel hydroburst and every specimen broken in the laboratory was examined on the fracture surface to note any peculiarities. Investigation of the fracture surface of one hydroburst cylinder revealed a small suspect area. Properties are given for the materials evaluated, and comparisons are made. The tests completed on the materials indicate that a substantial increase in strength can be obtained by using a more favorable orientation of the crystal structure of anisotropic materials. C.L.W.

34 STRUCTURAL DESIGN

Includes structural elements; and weight analysis. *For related information see:* 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 33 Stresses and Loads.

N64-15500 Republic Aviation Corp., Farmingdale, N. Y. Mfg. Res. Dept.

ELECTRO-SPARK EXTRUDING Interim Progress Report No. 2, 1 Oct. 1963–1 Jan. 1964

B. Leftheris, G. Pfanner, and J. H. Wagner Wright-Patterson AFB, Ohio, Aeron. Systems Div., Jan. 1964 71 p refs

(Contract AF 33(657)-11265)

(RAC-2027; ASD-TR-8-111(2); AD-427159)

The propagation of pressure pulse phenomena and their ensuing effects are applied to the extrusion billet-die interface and pressure-vessel container design by the formulation of a general solution derived from unsteady flow considerations. Specific application is pointed up in pressure-vessel design by the assumption of reasonable postulates and application of them to solution of the problem. Author

N64-15574 General Dynamics/Fort Worth, Tex.

MATERIAL– BRAZED STAINLESS STEEL SANDWICH– EXPOSURE TO WEATHERING UNDER SEASHORE CONDITIONS– EFFECT ON–

W. F. Heidbrier 8 May 1962 33 p refs

(Contract AF 33(600)-41891; Contract AF 33(657)-11214)

(FGT-2948; AD-429913)

The condition of the four brazed honeycomb sandwich panels was periodically checked by flash testing. One panel, with silver–manganese brazing alloy (unihibited), failed the flash test after 9 months' exposure. Two other silver–manganese brazed panels (inhibited against corrosion) failed the flash test after 17 months' exposure. The remaining panel, with silver–copper–lithium brazing alloy, was returned intact to Fort Worth after 38 months' exposure. It was subsequently flash tested without failure, and was then structurally tested in torsional shear to an ultimate failing stress of 77,000 psi (calc.). This test demonstrated the superior corrosion-resistance qualities of Ag–Cu–Li brazing alloy for 17-7 PH stainless steel sandwich pannels. Author

N64-15696 Aerojet-General Corp., Sacramento, Calif. Solid Rocket Plant

INVESTIGATION OF FILAMENT-WINDING PATTERNS Fourth Bimonthly Report, 24 Oct.–24 Dec. 1963

31 Jan. 1964 12 p

(Contract NOw 63-0627c (FBM))

(Rept. 0627-I-4; AD-429401)

This report describes progress in a program conducted to increase the understanding of the interrelation between chamber-winding patterns and chamber behavior. All ten chambers required for Phase I of this program have been fabricated. Seven of the units have been hydrostatically tested, and the data have been analyzed. Evaluation of the developed analytical approach relating to deformation control of isotensoid head shapes has been initiated. Author

N64-15870 Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.

INVESTIGATION OF STRUCTURAL PROPERTIES OF FIBER GLASS FILAMENT-WOUND PRESSURE VESSELS AT CRYOGENIC TEMPERATURES Monthly Progress Report No. 7, 1 Jan.–31 Jan. 1964

J. M. Toth, Jr. 3 Feb. 1964 55 p refs

(NASA Contract NAS3-2562)

(NASA CR-55651) OTS: $5.60 ph, $1.85 mf

Cryogenic cyclic lines were evaluated. A nickel-lined specimen was cycled 250 times at 36% of ultimate (600 psi). A glass-flake-lined specimen leaked excessively at a pressure of

270 psi, a Mylar-lined specimen leaked excessively at 360 psi, and an H-Film-lined specimen leaked excessively at 355 psi. Another nickel-lined specimen was cycled twice at 93% of ultimate (1,540 psi). Based upon the results, electrodeposited nickel linings will be used for the 18-in.-diam. pressure vessels. Engineering, tooling, and manufacturing are in the final phases for the development of the initial nickel-lined 18-in.-diam. vessel. Author

N64-15890* Goodyear Aerospace Corp., Akron, Ohio
ADVANCED CONCEPT INFLATABLE PARAGLIDER MODEL MATERIAL AND STRUCTURAL TESTS Summary Report
18 Nov. 1963 256 p refs
(NASA Contract NAS1-3020)
(NASA CR-55722; GER-11256)

The elastic characteristics of inflated curved beams to be used for the design of advanced concept paragliders were evaluated. Theories were developed for determining stresses and deflections, and correlation was obtained through comparison with values obtained from tests on structural components. Author

N64-16004* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
STRUCTURES AND MATERIALS
R. R. Heldenfels and A. Hurlich (General Dynamics/Astronautics) Repr. from Astronautics and Aerospace Eng., Nov. 1963 p 75–78

Recent developments in many areas of structures and materials technology are discussed as follows: (1) structural design criteria and reliability, (2) meteoroid impact and penetration, (3) properties of composite structures, (4) constructional metals, and (5) refractory metals, protective coatings, and ceramics. R.T.K.

N64-16007* Case Inst. of Tech., Cleveland, Ohio
STRUCTURAL SYNTHESIS CAPABILITY FOR INTEGRALLY STIFFENED WAFFLE PLATES
Lucien A. Schmit, Jr., Thomas P. Kicher, and William M. Morrow Repr. from AIAA Journal, v. 1, no. 12, Dec. 1963 p 2820–2836 refs Presented at the AIAA Launch and Space Vehicle Shell Structures Conf., Palm Springs, Calif., April 1–3, 1963
(NASA Grant NsG-110-61)

Structural synthesis has been defined as the rational directed evolution of a structural configuration which, in terms of a defined criterion, efficiently performs a set of specified functional purposes. An automated, minimum weight, optimum design capability for rectangular, simply supported waffle plates subjected to a multiplicity of inplane load conditions is presented. The synthesis involves six design parameters (total depth, backup sheet thickness, stiffener thickness in the x and y directions, and stiffener spacing in the *x* and *y* directions). The behavior constraints are provided primarily by elastic stability failure modes. In particular, gross instability of the waffle plate, buckling of the backup sheet panel, and stiffener buckling are prevented in each of several load conditions while seeking a minimum weight design configuration. The mathematical programing problem to which this structural synthesis problem leads is described. Author

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